









*Smith*

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UNITED STATES NATIONAL MUSEUM

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## ADVERTISEMENT

The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings*, begun in 1878, is intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects. The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

The present volume is the seventy-fifth of this series.

The *Bulletin*, the first of which was issued in 1875, consists of a series of separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogues of type-specimens, special collections and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

ALEXANDER WETMORE,

*Assistant Secretary, Smithsonian Institution.*

WASHINGTON, D. C., November 16, 1929.



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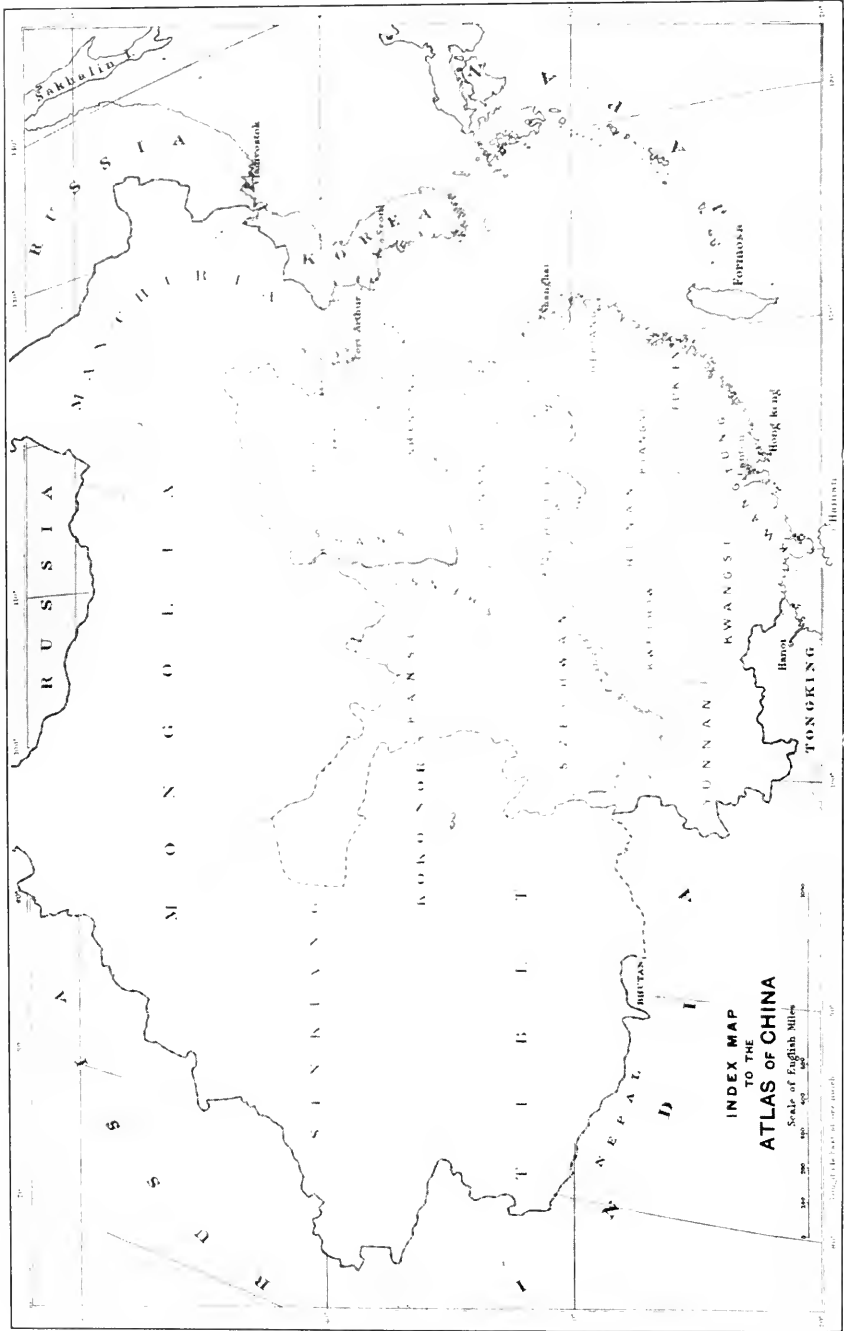
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MAP OF CHINA

FOR DESCRIPTION SEE PAGE 82

# MAMMALS FROM CHINA IN THE COLLECTIONS OF THE UNITED STATES NATIONAL MUSEUM

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By A. BRAZIER HOWELL

*Collaborator, United States National Museum*

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During recent years the attention of naturalists has been directed more and more to the fauna of Asia. The great variation in climate and topography have contributed in making this part of the earth's surface a region of extreme interest and the inaccessibility of a considerable portion of it has only stimulated our curiosity. That era in the history of Asiatic zoology when the majority of species obtained by an expedition proved to be new to science has largely passed, although novelties have by no means been exhausted. The time has come when an attempt should be made to sort and arrange what information we already have, to scrutinize the known species and establish their interrelationship, to correlate their ranges with what we know of faunal areas, and to bring as much order out of partial chaos as present circumstances permit.

The United States National Museum has accumulated from various sources a collection of Chinese mammals that is large and of extreme interest, and it seems eminently suitable that a report relating to it should be published at this time. The purpose of this may be said to be twofold: to present additional information concerning the mammals of regions that have been but imperfectly known; and to make available to students of Chinese mammalogy, who are not in contact with large collections and libraries, some of the information which they may require.

The Chinese collections of the National Museum include adequate series of quantities of genera and species. Others, however, are represented by so few or such unsatisfactory specimens that in the absence of comparative material identification can at times be but provisional. In the case of the carnivores, especially, variation is frequently very great and new races in the greatest profusion as well as confusion have been described from very scanty material, often the flat pelt of a native hunter from no one knows exactly where. When such a condition is further complicated by a vague description, all one

is able to do is to weigh facts and probabilities carefully and reach a personal conclusion which may or may not be correct. However, when the material has been unsatisfactory for proper identification in the present connection the fact is so stated.

The region included in the following report comprises the present Chinese Empire, including Mongolia, Manchuria, Korea, and the island of Hainan. There are listed a few specimens labelled eastern Tibet, which is permissible for the reason that at least until recent times, "eastern Tibet" was used in a very loose geographic sense, and as often as not included localities which are now within the Chinese provinces of Szechwan or Yunnan.

Upon initiating the present work it was determined to make a praiseworthy endeavor to reduce to a common plan of spelling the names of all Chinese localities mentioned, but this good intention was speedily abandoned. There are a number of different methods of changing the spelling of Chinese names to conform to our exotic ideas and one can never be sure which of these schemes was followed by the writer of a label or an article. Hence it is obvious that one can never be sure whether two slightly different names refer to the same spot or to separate places, perhaps not given on available maps. Clearly the only safe course at present, to avoid still greater confusion, is to list all names exactly as stated on the labels or in the literature, save in the case of well-known cities or provinces, when the spelling may be made uniform.

As a geographic basis I have used the atlas, 1917 edition, of the China Inland Mission, and when this failed me recourse was had to numerous other maps and atlases. Unfortunately there seems to be no good map of China which takes into adequate account the mountain ranges, and this fact renders extremely difficult a proper appreciation of the zonal barriers existing in such mountainous Provinces as Szechwan and Yunnan. Hence mistakes in the supposed ranges of such forms as these barriers affect are at times unavoidable.

The material upon which this report is based comprises 2,106 specimens of 283 species and subspecies, all of them belonging to the National Museum collections. These are mostly well-made skins with skulls, but there is also a considerable number of spirit specimens and a few skeletons. In addition there are sundry unlisted specimens which it was impossible to identify for one reason or another, such as odd skulls without locality, alcoholics of nestling rodents, etc. The listed specimens belong to 9 orders and 31 families as follows:

| Mammalia                                 | Forms | Specimens | Page |
|--|-------|-----------|------|
| Insectivora (total).....                 | 27    | 105       | 5    |
| Tupaïidae.....                           | 2     | 5         | 5    |
| Erinaceidae.....                         | 5     | 16        | 5    |
| Talpidae.....                            | 7     | 16        | 7    |
| Soricidae.....                           | 13    | 68        | 8    |
| Chiroptera (total).....                  | 35    | 353       | 11   |
| Emballonuridae.....                      | 1     | 9         | 11   |
| Rhinolophidae.....                       | 4     | 71        | 11   |
| Hipposideridae.....                      | 5     | 76        | 12   |
| Vespertilionidae.....                    | 24    | 197       | 15   |
| Carnivora (total).....                   | 45    | 127       | 20   |
| Ursidae.....                             | 5     | 9         | 20   |
| Procyonidae.....                         | 1     | 2         | 23   |
| Canidae.....                             | 6     | 10        | 23   |
| Mustelidae.....                          | 18    | 68        | 24   |
| Viverridae.....                          | 6     | 19        | 30   |
| Felidae.....                             | 9     | 19        | 32   |
| Primates: Cercopitheidae<br>(total)..... | 5     | 19        | 34   |
| Rodentia (total).....                    | 120   | 1,256     | 36   |
| Sciuridae.....                           | 47    | 295       | 36   |
| Muscardinidae.....                       | 1     | 4         | 48   |
| Cricetidae.....                          | 26    | 277       | 48   |
| Rhizomyidae.....                         | 2     | 8         | 54   |
| Spalacidae.....                          | 4     | 41        | 54   |
| Muridae.....                             | 33    | 602       | 56   |
| Zapodidae.....                           | 2     | 3         | 66   |
| Dipodidae.....                           | 4     | 25        | 66   |
| Hystricidae.....                         | 1     | 1         | 68   |
| Lagomorpha (total).....                  | 20    | 103       | 68   |
| Ochotonidae.....                         | 12    | 56        | 68   |
| Leporidae.....                           | 8     | 47        | 71   |
| Artiodactyla (total).....                | 28    | 132       | 73   |
| Suidae.....                              | 3     | 14        | 73   |
| Cervidae.....                            | 15    | 81        | 74   |
| Bovidae.....                             | 10    | 37        | 78   |
| Edentata: Manidae (total).....           | 2     | 2         | 81   |
| Cetacea: Odontoceti (total).....         | 2     | 9         | 81   |

Foremost in importance among these Chinese collections are the mammals secured by Arthur de C. Sowerby and donated to the Museum by Robert Stirling Clark. These number 1,319 items. They are mostly from the provinces of Shansi and Shensi, Chihli and Kansu, as well as many from Manchuria and Mongolia. Of great importance also is a collection of 440 specimens from south China,

almost all of them from Fukien. Much of the early material taken by Mr. Sowerby and received nearly 20 years ago was identified by G. S. Miller, jr., not a few of them by means of comparisons which he made with types in the British Museum, but advances made in our knowledge of Chinese mammals since that time has necessitated the reworking of this material.

Next in numerical importance are 205 mammals collected by F. R. Wulsin on the National Geographic Society's Central China expedition and presented to the Museum by that organization. A number of provinces are represented among this material but of outstanding importance are his collections from Inner Mongolia and from the Minshan Mountains of southern Kansu—both regions of exceptional interest and otherwise unrepresented in the National collection.

Dr. David C. Graham, in the course of his missionary work, has taken occasion to collect under the auspices of the Museum 178 specimens of mammals, most of them being from the Province of Szechwan. It has been his fortune to secure more than a fair share of extremely rare species, and his efforts have been of exceeding value.

Dr. W. L. Abbott has presented to the Museum 186 mammals collected under his auspices by the late Charles M. Hoy. These are almost exclusively from the neighborhood of Yochow, Hunan, a district which is otherwise almost unrepresented in the National collection.

Also donated by the National Geographic Society is a collection of 61 mammals secured by J. F. Rock, mostly in Yunnan, which includes many rare squirrels as well as some desirable carnivores.

To the generosity of W. W. Simpson, who was engaged for some time in missionary work at Taohow, Kansu, the Museum is indebted for 38 mammals, mostly from Kansu, among which are such desirable items as gorals, stags, and an extremely rare bear.

Smaller but valuable collections have, in addition, been received as follows: From S. F. Light, 16 mammals from Hainan and the mainland adjacent; from C. B. Rickett, 12 mammals, mostly from Fukien; from A. P. Jacot, 7 mammals from Shantung; and from Canton Christian College museum, 5 mammals. This leaves 84 mammals from miscellaneous sources. These include specimens in the collection of C. Hart Merriam, material secured in exchange from many institutions, and the odds and ends that have accumulated throughout the years.

As a result of the present study, 18 species and subspecies have been described as new by the writer, and one by G. S. Miller. In addition, Miller, Lyon, Hollister, and Sowerby previously described 23 new forms based on this material, making a total of 42 new forms that have been described from the Chinese mammals now in the collection of the United States National Museum.

Unfortunately Mr. Sowerby is the only one of the above collectors who kept field records of anything more than the actual specimens collected, and his notes regarding habits are only available for the collections which he made in Shansi, Shensi, and a part of Kansu. Many of these observations are included under their proper headings in this report. Others have been included in his books, among which are *Through Shen-kan, 1912*; *Fur and Feathers in North China, 1914*; *A Sportsman's Miscellany, 1917*; and *Sport and Science on the Sino-Mongolian Frontier, 1918*.

## Order INSECTIVORA

### Family TUPAIIDAE

#### Genus TUPAIA Raffles

##### TUPAIA BELANGERI CHINENSIS Anderson

*Tupaia chinensis* ANDERSON, Zool. Res. West. Yunnan, 1879, p. 129 (Ponsee, Kakhyen Hills, western Yunnan, China).

*Specimens*.—Four, from the following localities in Yunnan: Yunlung, Tsaochiang, Likiang plain, and the fourth from an unknown locality.

The coloration of three of these specimens is of an exceedingly grayish cast, but that from Likiang is more ochraceous. Sufficient Chinese examples of this genus are not yet available for an adequate understanding of the geographic variation occurring. Undoubtedly there yet remain one or more forms to be described.

##### TUPAIA BELANGERI MODESTA J. A. Allen

*Tupaia modesta* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 22, 1906, p. 481 (Leimuimon, Hainan, China).

*Specimen*.—One, from Kachek, Hainan.

This is a flat skin in poor condition but the skull is perfect.

### Family ERINACEIDAE

#### Genus NEOTETRACUS Trouessart

##### NEOTETRACUS SINENSIS Trouessart

*Neotetracus sinensis* TROUSSERT, Ann. Mag. Nat. Hist., ser. 8, vol. 4, 1909, p. 390 (Tatsienlu, Szechwan, China).

*Specimen*.—One, from Homushu Pass, probably Szechwan.

This is the only specimen of this interesting genus in the National collection. It was obtained by exchange with the American Museum of Natural History.

Genus **ERINACEUS** Linnaeus**ERINACEUS AMURENSIS** Schrenck

*Erinaceus amurensis* SCHRENCK, Reis. Amur-Lande, vol. 1, 1858, p. 10 (Amur, Siberia).

*Specimen*.—One, from 60 miles southwest of Kirin, Manchuria.

The hedgehogs of this region remain properly to be worked out. *E. orientalis* and *usurriensis* are of the *europaeus* type of marking, while *chinensis* resembles, and is probably the same as, *dealbatus*. *E. koreanus*, which is doubtfully valid, is said to have the shoulders white. Differences in the claws, as given by Lonnerberg (1922), are probably not trustworthy. Finally *koreanus* is said to have the dorsum much darker than typical *amurensis*, and undoubtedly darker than the present specimen. On the whole, the coloration of this Kirin skin is much like specimens of *hanensis* from Hunan, but the skull is smaller, with the bullae weaker and lower.

**ERINACEUS DEALBATUS** Swinhoe

*Erinaceus dealbatus* SWINHOE, Proc. Zool. Soc. London, 1870, p. 450 (Peking, Chihli, China).

*Specimens*.—Two, from Tientsin, Chihli.

One of these specimens is an immature with all spines virtually white, so that one suspects it may be a partial albino.

**ERINACEUS HANENSIS** Matschie

*Erinaceus hanensis* MATSCHIE, Wissens. Erg. Exped. Filchner China und Tibet, vol. 1, pt. 1, 1908, p. 138 (Hankow, Hupeh, China).

*Specimens*.—Five skins and six skulls: two from Shanghai, Kiangsu; one from Ningpo, Chekiang; and two, with additional skull, from Yochow, Hunan.

The Hunan specimens are presumed to be typical of *hanensis*, which seems to be a valid race. The wholly white spines are rather numerous and the darker ones are quite brown, but paler than in examples from nearer the coast, which are without measurements.

Genus **HEMIECHINUS** Fitzinger**HEMIECHINUS ALBULUS ALASCHANICUS** Satunin

*Hemiechinus albulus alaschanicus* SATUNIN, Ann. Mus. Zool. St. Petersb., vol. 11, 1906, p. 181 (Alashan, Mongolian-Kansu border, China).

*Specimens*.—Four, from northwest of Ninghsia, Kansu.

These examples are from near the type locality. As the describer states, they are paler than *typicus*, the silky hairs of the underparts being virtually pure white. The skull is also smaller and narrower and the premaxillary tips extend farther caudad. This race is larger



than *minor* and the concavity of the postglenoid process extends onto the mastoid in a fashion that is not found in that form. The species *miodon* is evidently entirely distinct.

### Family TALPIDAE

#### Genus UROPSILUS Milne-Edwards

##### UROPSILUS SORICIPES Milne-Edwards

*Uropsilus soricipes* MILNE-EDWARDS, Nouv. Arch. Mus., 1871, p. 92 (Muping, Szechwan, China).

*Specimen*.—One, from Taochow, the province given as Szechwan, but I know of no locality of this name save in Kansu.

In recording Zappey's specimens, G. M. Allen (1912) called attention to the great dental variation shown by this series of insectivores, indicating that this covered the characters of the genus *Rhynchonax* Thomas. Later (1923), however, he recognized this as a valid genus. The single specimen before me was one of the Zappey series and it has 18 teeth in the upper series and the same number below, the former agreeing with *Uropsilus*, and the latter with *Rhynchonax* (rather than *Nasillus*). Until some one has access to sufficient material to settle the moot points involved, I prefer to adopt a conservative attitude.

#### Genus MOGERA Pomel

##### MOGERA LATOCHEI Thomas

*Mogera latouchei* THOMAS, Proc. Zool. Soc. London, 1907, p. 463 (Kuatun, Fukien, China).

*Specimens*.—Two; from Kuatun, Fukien, and Tseogiakeo, Szechwan.

In the above topotype the first upper premolar is a trifle longer than the second—not shorter as stated by Thomas. The skull of the Szechwan specimen has a broader interpterygoid and smaller bullae, and it seems likely that when an adequate series is available separation will prove desirable.

##### MOGERA ROBUSTA (Nehring)

*Talpa robusta* NEHRING, Sitz.-Berich. Gesellsch. Naturf. Freunde, 1891, p. 95 (Vladivostok, Siberia).

*Specimen*.—One, from Fengtien, Manchuria.

This specimen lacks a skull but comparison of its fore feet with those of *coreana* leaves little doubt as to its identity.

##### MOGERA COREANA Thomas

*Mogera coreana* THOMAS, Proc. Zool. Soc. London, 1907, p. 463 (65 miles north-east of Seoul, Korea).

*Specimens*.—Four, from Fusan, Korea.

Genus **SCAPTOCHIRUS** Milne-Edwards**SCAPTOCHIRUS GILLIESI** Thomas

*Scaptochirus gillicsi* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 5, 1910, p. 350 (Hotsin, Shansi, China).

*Specimens*.—Six: 1 from Yulingfu, Shensi; 1 from Taiyuanfu, Shansi; and 4 from 20 miles west of Ningwufu, Shansi.

One of these is especially pale and so old that most of the enamel is worn from the teeth.

**SCAPTOCHIRUS LEPTURUS** (Thomas)

*Talpa leptura* THOMAS, Ann. Mag. Nat. Hist., ser. 5, vol. 7, 1881, p. 470 (Peking, Chihli, China).

*Specimen*.—One skull from Heisui, Manchuria.

The skin of this specimen is missing and as the skull is apparently somewhat immature, identity can be but provisional.

Genus **SCAPANULUS** Thomas**SCAPANULUS OWENI** Thomas

*Scapanulus oweni* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 397 (23 miles east of Taochow, Kansu, China).

*Specimen*.—One from Archuen, Minshan Mountains, Kansu.

This specimen matches the description of this species in all particulars.

Family **SORICIDAE**Genus **SOREX** Linnaeus**SOREX ANNEXUS** Thomas

*Sorex annexus* THOMAS, Proc. Zool. Soc. London, 1906, p. 859 (Mingyong, 110 miles southeast of Seoul, Korea).

*Specimen*.—One from the Sungaree River, Manchuria.

**SOREX BEDFORDIAE BEDFORDIAE** Thomas

*Sorex bedfordiae* THOMAS, Abst. Proc. Zool. Soc. London, No. 90, 1911, p. 3 (Mt. Omei, Szechwan, China).

*Specimen*.—One from Washan, Szechwan.

This is a poor skin without measurements and the skull is damaged, so that an exact determination is impossible. But in coloration and dental characters it agrees with *bedfordiae*.

Genus **BLARINELLA** Thomas**BLARINELLA WARDI** Thomas

*Blarinella wardi* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 15, 1915, p. 336 (Hpimaw, Upper Burma).

*Specimen*.—One from the Likiang Mountains, Yunnan.

This specimen, obtained in exchange from the American Museum, is the only representative of its genus in the national collection, and

G. M. Allen's original identification is accepted without comment. It may be mentioned, however, that Cabrera (1925) was mistaken in assigning as a generic character the presence upon the anterior mandibular incisor of but one denticle, for the dorsal border of this tooth is serrated.

### Genus SUNCUS Ehrenberg

#### SUNCUS MYOSURUS (Pallas)

*Sorex myosurus* PALLAS, Acta Acad. Petrop., vol. 10, 1785, p. 327.

*Specimens*.—Twenty-seven from the following localities in Fukien: Foochow, 8; Futsing (30 miles south of Foochow), 13; 70 miles southwest of Yenpingfu, 4; Kulingsu Island, near Amoy, 2, including one spirit specimen.

This is the "*Pachyura murina*" of authors, but J. A. Allen (1906) called attention to the fact that this specific name of Linnaeus' is not determinable among the several species of large shrews inhabiting Java. In searching for a name recourse was then had to *albinus* Blyth as listed as a subspecies of *indicus* by Cabrera (1925). This proves, however, to be no name, for Blyth merely stated that an *albino* was secured at Amoy. I therefore follow Cabrera (1922) in using the name *myosurus* for the Chinese animal. This course, notwithstanding, can be merely tentative until a revision of the Asiatic mainland forms of musk-shrew has been undertaken.

The skin from Kulingsu Island is a partial "albino," lacking black pigment and thus being entirely buffy. The spirit specimen from the latter locality, after the pelage had been dried, proved to be browner than mainland examples but it is extremely unlikely that there is a distinct race of such a wide-ranging species upon this small island so close to the mainland.

### Genus CROCIDURA Wagler

#### CROCIDURA ATTENUATA ATTENUATA Milne-Edwards

*Crocidura attenuata* MILNE-EDWARDS, Nouv. Arch. Mus., 1871, p. 91 (Muping, Szechwan, China).

*Specimens*.—Five; two from Yoehow, Hunan; and three, including two in spirits, from Suifu, Szechwan.

It is assumed that the Hunan skins are fairly typical. At any rate they differ from *grisea* in having the hind foot a trifle longer and in being slightly less gray, or browner. The Suifu skin was made up from a shrunken, salted pelt, and its skull is broken, so little can be told about it.

#### CROCIDURA ATTENUATA GRISEA A. B. Howell

*Crocidura grisea* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 39, 1926, p. 137 (75 miles southwest of Yenpingfu, Fukien, China).

*Specimens*.—Four, from the following localities in Fukien; 70 and 75 miles southwest of Yenpingfu, 3 (including the type); and Kuliang, near Foochow, 1.

A typographical error in the original description gave the maxillary tooth row of the type as 6.5 instead of 8 mm.

#### CROCIDURA COREAE Thomas

*Crocidura coreae* THOMAS, Proc. Zool. Soc. London, 1907, p. 860 (Mingyong, 110 miles southeast of Seoul, Korea).

*Specimens*.—Six: 3 from 5 miles south of Taiyuanfu, Shansi; and 3 in spirits from Fusan, Korea.

The three skins seem to be fairly typical of this palish, gray-brown species with whitish belly and bicolored tail—the only small white-footed *Crocidura* of this part of China. The only Fusan skull that has been removed and cleaned differs from the Shansi examples only in points which are believed to be of minor importance; but the pelage is so faded after its immersion in the preservative for 40 years that the present color signifies nothing.

#### CROCIDURA DRACULA GRISCESCENS A. B. Howell

*Crocidura griscescens* A. B. HOWELL, Journ. Mamm., vol. 9, 1928, p. 60 (Kuatun, Fukien, China).

*Specimens*.—Two, the type and a topotype.

This is undoubtedly a small, browner, eastern race of *dracula*, as already mentioned.

#### CROCIDURA LASIURA Hodgson

*Crocidura lasiura* HODGSON, Ann. Mag. Nat. Hist., ser. 6, vol. 5, 1890, p. 31 (Ussuri River, Manchuria).

*Specimens*.—Five; four from the Sungaree River, Manchuria, and a skull only from Fusan, Korea.

The above skins of this large, dark, rather short-tailed species are in summer pelage. One of the males is unusually large, measuring 104 (head and body) by 48 by 16.5 mm.

#### CROCIDURA RAPAX G. M. Allen

*Crocidura rapax* G. M. ALLEN, Amer. Mus. Nov., No. 100, 1923, p. 9 (Yingpankai, Mekong River, southern Yunnan, China).

*Specimens*.—Five, from Yochow, Hunan.

These apparently are perfectly typical.

#### CROCIDURA SHANTUNGENSIS Miller

*Crocidura shantungensis* MILLER, Proc. Biol. Soc. Wash., vol. 14, 1901, p. 158 (Chimeh, Shantung, China).

*Specimen*.—One, the type.

**Genus ANOUROSOREX Milne-Edwards****ANOUROSOREX SQUAMIPES SQUAMIPES Milne-Edwards**

*Anourosorex squamipes* MILNE-EDWARDS, Comptes Rendus Acad. Sci. Paris, vol. 70, 1870, p. 341 (Szechwan and Tibet).

*Specimens*.—Nine; 2 from Wanshan, and 7, including 3 in spirits, from Suifu, both in Szechwan.

The Suifu skins are in rather harsh pelage and lack brown cheek marks, but G. M. Allen has kindly compared them with the good series of this genus in the Museum of Comparative Zoölogy and pronounced them as belonging to the typical race.

**Genus CHIMARROGALE Anderson****CHIMARROGALE HIMALAYICA (Gray)**

*Crossopus himalayicus* GRAY, Ann. Mag. Nat. Hist., vol. 10, 1842, p. 261.

*Specimen*.—One from the Likiang Mountains at 10,000 feet, Yunnan.

This animal is evidently extremely rare in China.

**Order CHIROPTERA****Family EMBALLONURIDAE****Genus TAPHOZOUS Geoffroy****TAPHOZOUS SOLIFER Hollister**

*Taphozous solifer* HOLLISTER, Proc. Biol. Soc. Wash., vol. 26, 1913, p. 157 (near Peking, Chihli, China).

*Specimens*.—Nine, including the type, from the type locality.

**Family RHINOLOPHIDAE****Genus RHINOLOPHUS Lacépède****RHINOLOPHUS BLYTHI CALIDUS G. M. Allen**

*Rhinolophus blythi calidus* G. M. ALLEN, Amer. Mus. Nov., No. 85, 1923, p. 1 (Yenpingfu, Fukien, China).

*Specimens*.—Seventeen from the following localities in Fukien: Yenpingfu 15 and Futsing 2.

The topotypes are in perfect accord with the measurements given by the describer. Those in spirits are very similar to European examples of *R. hipposideros* save that the metacarpal formula is different, and in the Fukien bats the border of the ear is less sharply concave, the horseshoe is a trifle larger, sella broader and lancet high and much wider. The skull differences are very slight, the chief one being the broader interorbital.

**RHINOLOPHUS BLYTHI SZECHWANUS** Anderson

[*Rhinolophus*] [*blythi*] *szechwanus* ANDERSON, Ann. Mag. Nat. Hist., ser. 9, vol. 2, 1918, p. 377 (Chunking, Szechwan, China).

*Specimens*.—Seven in spirits from Suifu, Szechwan.

I am not entirely convinced that this disposition of the above material is correct, but no other course is practicable at present. They clearly have no close affinity with the *macrotis* or *hipposideros* groups. From Fukien examples of *R. b. calidus* they differ in longer forearm (average 41.8 mm.), broader horseshoe, higher sella, and appreciably larger foot and thumb. The skulls are virtually indistinguishable.

**RHINOLOPHUS ROUXI SINICUS** Anderson

*Rhinolophus rouxi sinicus* ANDERSON, Proc. Zool. Soc. London, 1905, p. 98 (Chintah, Anhwei, China).

*Specimens*.—Forty-one from the following localities in Fukien: Yenpingfu, 40, including 25 in spirits; 1 from Foochow in spirits.

On the whole the above specimens are nearest this race, although there are some variations, as longer tail. The skull of the Foochow example does not seem to be typical, but as it was removed from the alcoholic and is in bad condition, little can be told from it.

**RHINOLOPHUS AFFINIS MACRURUS** Anderson

*Rhinolophus affinis macrurus* ANDERSON, Proc. Zool. Soc. London, 1905, p. 103 (Taho, Karennee, Burma, India).

*Specimens*.—Six, including one in spirits, from Yenpingfu, Fukien.

The phalangeal formula places these skins with the *affinis* rather than the *pearsoni* group. It seems likely that the Chinese animals will eventually prove to be distinct, but for the present, on the basis of measurements given by Anderson, the Fukien material must be referred to this race rather than to *himalayanus*.

## Family HIPPOSIDERIDAE

## Genus HIPPOSIDEROS Gray

**HIPPOSIDEROS GENTILIS SINENSIS** Anderson

(*Hipposideros*) *g(entilis) sinensis* ANDERSON, Ann. Mag. Nat. Hist., ser. 9, vol. 2, 1918, p. 380 (Foochow, Fukien, China).

*Specimens*.—Fifteen, including five in spirits, from Yenpingfu, Fukien.

Anderson's terse characterization of this race is anything but satisfactory, but *sinensis* is the only small member of this genus to have been described from China.

## HIPPOSIDEROS PRATTI Thomas

*Hipposideros pratti* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 7, 1891, p. 527 (Kiating, Szechwan, China).

*Specimens*.—Thirty: 11 from Changshowkai, Hunan; 1 skull from Futsing, and 19 from Yenpingfu, Fukien.

The Hunan examples are a trifle smaller than those from Fukien. Two of them are considerably more sooty than any in the series from farther east. It is interesting to find that this fine species occurs near the coast of China. Thomas' description was evidently based upon a single spirit specimen; hence, no reliable color characters could then be offered, and no skull characters were given. In view of these facts it is at present impossible to differentiate subspecifically these coast specimens, although it is not improbable that such a course may prove desirable in the future. Average measurements of 14 females and 1 male are: Head and body, 99.4; forearm, 88.5; shank, 34.3; tail, 58.3; ear, 33.3; foot, 20; thumb, 11.8; length of skull, 32.6; palatal length, 4.6; pterygoid width, 4.6; and narial width, 6.5 mm. The averages of metacarpal length for several specimens are: second, 66.2; third, 63; and fourth, 63 mm.

Superficially the present series of skins might easily be mistaken for *swinhoii*, but further examination discloses many fundamental differences. The character that at once distinguishes *pratti* from any other bat of this genus now known is the form of the skin folds upon either side of the nasal sac. In dried skins these are not so apparent, but they serve to identify spirit specimens at a glance. This species evidently does not belong to the *armiger* group, but both because of the superficial resemblance which it bears to the latter and their occurrence not only in the same locality but evidently in the same caves, it seems advisable to offer comparisons.

In describing *pratti* Thomas stated that in size it is exceeded by only three members of the genus. But the type is a female that is smaller than any of those at hand. These coast examples are, then, close to the maximum size for the genus and are larger in head-and-body length than *swinhoii*. In comparison with the last-mentioned, *pratti* is slightly larger, with shorter forearm and shank, much longer foot and thumb, and broader ear. In the skull the frontal declivity is concave instead of being almost straight, the rostrum and narial openings are much broader and the rostral borders diverge instead of being parallel as in *swinhoii*. The palate is shorter, interpterygoid width greater, width of basisphenoid less, and sphenoidal foramina larger, these being conspicuous in ventral view instead of almost hidden as in *swinhoii*. *H. pratti* as represented shows indications of being a dichromatic species, for two of the skins are in a sooty grayish phase and there is one quite as bright reddish as any

specimen of *swinhoii*; but the remainder are intermediate in tone. The hairs of the head and shoulders of *pratti* almost entirely lack the darker tips to the hairs such as occur over the remainder of the body, thus rendering the specimens lighter anteriorly. This is so to a considerably greater degree than in *swinhoii*. The nasal details of the spirit specimens are substantially as given by Thomas. They are not, however, more pronounced in the single male alcoholic than in the females, as might be inferred to be the case.

**HIPPOSIDEROS ARMIGER ARMIGER (Hodgson)**

*Rh(nolphus) armiger* HODGSON, Journ. Asiatic Soc. Bengal, vol. 4, 1835, p. 699 (central region of Nepal, India).

*Specimens.*—Seven: from Kiating, 1, Suifu, 1, and Hwangtsaopa, 1, all in Szechwan; and from Changshowkai, Hunan, 4.

The specimen from Hwangtsaopa is as small as any *swinhoii* but is identified on geographic grounds.

**HIPPOSIDEROS ARMIGER SWINHOII (Peters)**

*Phyllorhina swinhoii* PETERS, Proc. Zool. Soc. London, 1870, p. 616 (Amoy, Fukien, China).

*Specimens.*—Twenty-three, including 9 in spirits, from Yen-pingfu, Fukien.

For comparison with *pratti* average measurements of 14 females are given as follows: Length of head and body, 96.6; forearm, 93; shank, 39; tail, 59; ear, 33.5; foot, 16.9; thumb, 9.9; length of skull, 31.8; palatal length, 5.4; pterygoid width, 3.5; and narial width, 5.1 mm.

Andersen did not recognize the race *swinhoii*, but with access apparently to a larger series of skins G. M. Allen (1923) considered it to be a valid form, based on brighter color, typifying the coastal representative of the *armiger* group. The specimens before me do not altogether bear out this statement. It is true that some of the Fukien skins are much brighter than are four from Hunan, but definite dichromatism is indicated and six of the lot from the former province are smoky gray, while four may be said to be intermediate. A difference is found in the ground color of the pelage, however, which is paler and more buffy in four Hunan skins than in any of those from Fukien; and the former are appreciably larger, both in body and skull.

It may be mentioned that judging from the rather scanty representation of bats of the *H. diadema* group in the national collection, races of *H. armiger* appear to differ in having the border of the bony palate definitely V instead of U shaped, and in having the borders of the basisphenoid and basioccipital parallel.



## Genus COELOPS Blyth

## COELOPS INFLATA Miller

*Coelops inflata* MILLER, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 85 (near Yenpingfu, Fukien, China).

*Specimen*.—One, the type.

## Family VESPERTILIONIDAE

## Genus MYOTIS Kaup

## MYOTIS CHINENSIS LUCTUOSUS G. M. Allen

*Myotis chinensis luctuosus* G. M. ALLEN, Amer. Mus. Nov., No. 85, 1923, p. 5 (Wanh sien, Szechwan, China).

*Specimens*.—Seven: Yenpingfu, Fukien, 1; Hwangtsoapa, Keichow, 1; and Changshowkai, Hunan, 5.

These all conform to the characters mentioned in the original description.

## MYOTIS DAVIDII (Peters)

*Vespertilio davidii* PETERS, Monatsb. Akad. Wissensch. Berlin, 1869, p. 402 (Peking, Chihli, China).

*Specimen*.—One from Hsinlingshan, Chihli.

This bat is very like *M. daubentonii* but is a trifle darker and the second premolar, both above and below, is internal and excessively crowded.

## MYOTIS FORMOSUS (Hodgson)

*Vespertilio formosus* HODGSON, Journ. Asiatic Soc. Bengal, vol. 4, 1835, p. 700 (Formosa).

The mainland bat of this rufous and black type has been described under the name *rufo-niger* Tomes, but I believe that the validity of the latter has not been satisfactorily established. The National Museum has two alcoholics from Formosa and in comparison with these the characters of the ear, which Tomes ascribed to the Chinese animal, are not discernable.

## MYOTIS HIRSUTUS A. B. Howell

*Myotis hirsutus* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 39, 1926, p. 139 (near Yenpingfu, Fukien, China.)

*Specimens*.—Thirteen, including the type, from Yenpingfu.

This seems to be the Chinese representative of the European *Myotis capaccinii* and the relationship may ultimately prove to be only subspecific. Average measurements of 12 specimens are as follows: Length of head and body, 48; tail, 39; ear, 15; forearm, 39; thumb, 6.8; shank, 15.1; foot, 10.4; total length of skull, 15.1;

palatal length, 6.6; mastoid width, 7.5; and maxillary tooth row, 6.7 mm.

**MYOTIS IKONNIKOWI** Ognev

*Myotis ikonnikovi* OGNEV, Ann. Mus. Zool. Acad. Imp. Sci. St. Petersburg, vol. 16, 1911 (1912), p. 477 (Evseevka, Priamur Govt., Siberia).

*Specimen*.—One from Imienpo, Kirin, Manchuria.

As cranial characters were not given in the original description of this form identification must be tentative; but the dimensions are smaller (forearm 31 mm.) than *gracilis* or any other bat which it might possibly be. It is darker as well as smaller than *M. mystacinus* and its skull is a smaller replica of the latter.

**MYOTIS SOWERBYI** A. B. Howell

*Myotis sowerbyi* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 39, 1926, p. 138 (near Yenpingfu, Fukien, China).

*Specimens*.—Fifty-four: 1 from Foochow and the remainder (with the type), including 38 in spirits, from near Yenpingfu, Fukien.

As indicated in the original description, this bat shows considerable resemblance to *M. mystacinus* of Europe but differs chiefly in the small size of the lower incisor and large size of the first lower premolar. Average measurements of 2 male and 13 female topotypes are as follows: Length of head and body, 41.3; tail, 38.6; ear, 12.3; forearm, 34.8; thumb, 5.8; shank, 15; foot, 7.9; total length of skull, 13.2; palatal length, 5.5; mastoid width, 6.8; and maxillary tooth row, 5.7 mm.

**Genus PIPISTRELLUS** Kaup

**PIPISTRELLUS TRALATITIUS PUMILOIDES** (Tomes)

*Scotophilus pumiloides* TOMES, Proc. Zool. Soc. London, 1857, p. 51 (China).

*Specimens*.—Twenty-three: Shanghai, Kiangsu, 2; 70 miles southwest of Yenpingfu, Fukien, 2; Kachek, Hainan, 4; and Yochow, Hunan, 15.

In determining the south China pipistrelles I was glad to avail myself of the advice of G. M. Allen. He refers those of the *tralatitius* type to this race and considers that the Hunan material varies toward *abramus*. The smaller upper premolar is crowded and not visible from the side. Attention may be called to the error made by J. A. Allen (1906) in recording two species of *Myotis* from the island of Hainan, for his "*Myotis abramus*," included in his list on Swinhoe's authority, is clearly a *Pipistrellus*. It was merely an oversight, for he compares his *P. portensis* with *Pipistrellus abramus*.

**PIPISTRELLUS TRALATITIUS ABRAMUS (Temminck)**

*Vespertilio abramus* TEMMINCK. Monog. Mamm., vol. 2, 1835, p. 232 (Japan).

*Specimens*.—Seven: 5 from Tientsin and 2 from Peking, Chihli.

The variation, especially in the skull, in typical material from Japan is very great, and the north China pipistrelles of this type evidently fall well within this range.

**PIPISTRELLUS PULVERATUS (Peters)**

*Vesperugo pulveratus* PETERS, Proc. Zool. Soc. London, 1870, p. 618 (Amoy, Fukien, China).

*Specimens*.—Eighteen: Pingkiang, Hunan, 17; and Suifu, Szechwan, 1.

Both sexes of this grizzled, blackish pipistrelle are represented. The forearm length of males is close to 33 and of females 36 mm. The Suifu specimen can be identified only approximately, as there are no measurements and the forearms and skull are both broken.

**PIPISTRELLUS species**

There are at hand eight Chinese specimens of this genus which are not determinable at present. One, from Kuyuanchow, Kansu, is somewhat of the *P. savii* type, although the skull is smaller. The small upper premolar is very slender, long, and crowded, and it has been suggested to me that this may be an unusually persistent milk tooth, and that in reality it represents a very small species of *Eptesicus*. It does not resemble any milk tooth of the latter genus that I have examined and it hardly seems likely that such a milk tooth would persist equally on both sides of an adult bat; and there is nothing about the skin to indicate that it is not a pipistrelle. On the other hand, with the present dearth of Siberian material, I am unwilling to risk a specific identification of such a questionable specimen.

The remaining seven specimens are of small pipistrelles with forearm about 30 mm. or less. Four of them are spirit specimens and the fifth is a poor skin with imperfect skull. Of the two good specimens one seems unquestionably to represent a very dark sooty, rather than brownish, race of *P. pipistrellus*, but there is no name available, with description to fit, and it, of course, should not receive a new name on the basis of a single specimen. The other specimen is a slightly larger but equally sooty animal (forearm 30.5 mm.) with larger skull and small premolar internal to the tooth row. It is evidently of the *P. coromandra* type, but the lack of comparative material cuts short further inquiry.

## Genus NYCTALUS Lesson

## NYCTALUS MAXIMUS AVIATOR Thomas

*Nyctalus maximus aviator* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 8, 1911, p. 380 (Tokyo, Hondo, Japan).

*Specimens*.—Four in spirits from Fusan, Korea.

These examples are evidently indistinguishable from typical.

## NYCTALUS NOCTULA SINENSIS (Peters)

*Vesperus sinensis* PETERS, Monatsb. Akad. Wissensch. Berlin (1880), 1881, p. 258 (Peking, Chihli, China).

*Specimen*.—One in spirits from Hunan.

Comparative material is lacking but it is likely that the present example, of the *noctula* type, is closer to *sinensis* than to *labiata* of Nepal. Externally it is very close to typical European *noctula* but the skull is somewhat smaller.

## NYCTALUS species

*Specimens*.—Two from Mount Omei, Szechwan.

These comprise an immature and a newborn young. The former is at an indeterminate stage of growth and the skull is imperfect, but it seems to belong to a smaller form than *noctula* and possibly represents an Asiatic race of *leisteri*.

## Genus EPTESICUS Rafinesque

## EPTESICUS SEROTINUS PALLENS Miller

*Eptesicus serotinus pallens* MILLER, Proc. Biol. Soc. Wash., vol. 24, 1911, p. 53 (Chengyuanhsien, Kansu, China).

*Specimens*.—Seventeen: Chengyuanhsien, Kansu, 1 (the type); Kuyuanchow, Kansu, 1; Haishuisan, 1, and 80 miles south of Yenafu, Shensi, 2; Tientsin, Chihli, 2; and Tsingtao, Shantung, 10.

All but one of the Shantung specimens are juveniles. This one and the Chihli examples are somewhat darker below than typical *pallens*, but may be so allocated for the present.

## EPTESICUS SEROTINUS subspecies

*Specimens*.—Six: Changshowkai, Hunan, 5; and one from Suyki, whose province is unknown—possibly Fukien.

Four of the Hunan specimens are alcoholics. The other two can not be referred to *pallens*, for they are quite dark, with a different quality of coloration, and the skull—especially that to the Hunan skin—is narrow and rather small. Evidently they are not *andersoni*, nor can they be called typical *serotinus*. Without additional

specimens it would be unjustifiable to separate them and it is better for the present to leave them unnamed.

**Genus VESPERTILIO Linnaeus**

**VESPERTILIO MURINUS MURINUS Linnaeus**

(*Vespertilio murinus* LINNAEUS, Syst. Nat., vol. 1, ed. 10, 1758, p. 32 (Sweden).

*Specimens*.—Two: 120 miles north of Sansing, Manchuria, 1; and 85 miles north of Lanchow, Kansu, 1.

These are indistinguishable from the limited number of European specimens at hand.

**VESPERTILIO MURINUS SUPERANS Thomas**

*Vespertilio murinus superans* THOMAS, Proc. Zool. Soc. London, 1898, p. 770 (Sesalin, Ichang, Hupeh, China).

*Specimens*.—Six: Yochow, Hunan, 4; Tientsin, Chihli, 1; eastern China, 1.

These skins are but very slightly larger than true *murinus*, but the skulls are readily distinguishable by their size, greatest length being about 17 mm.

**Genus SCOTOMANES Dobson**

**SCOTOMANES ORNATUS SINENSIS Thomas**

*Scotomanes ornatus sinensis* THOMAS, Journ. Bombay Nat. Hist. Soc., vol. 27, 1921, p. 772 (Kuatun, Fukien, China).

*Specimen*.—Three from 50 miles southeast of Yochow, Hunan.

These specimens are the only representatives of the genus in the national collection.

**Genus PACHYOTUS Gray**

**PACHYOTUS KUHLLII INSULARIS (J. A. Allen)**

*Scotophilus kuhlpii insularis* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 22, 1906, p. 485 (Rintoi, or Rinsui, Hainan, China).

*Specimens*.—Two in spirits from Amoy Island, Fukien, and Kachek, Hainan.

The virtual topotype from Hainan appears to agree in every particular with the original description, and the Fukien example is indistinguishable except for being somewhat paler, possibly from the action of the preservative.

**Genus PLECOTUS Geoffroy**

**PLECOTUS SACRIMONTIS G. M. Allen**

*Plecotus sacrimontis* G. M. ALLEN, Bull. Mus. Comp. Zool., vol. 52, 1908, p. 50 (Mt. Fuji, Japan).

*Specimens*.—Nine from Wutingshan, Chihli.

This series clearly belongs with *sacrimontis* rather than *ariel*, but in the absence of typical material the exact amount of variation from the former is unknown.

**PLECOTUS ARIEL** Thomas

*Plecotus ariel* THOMAS, Abst. Proc. Zool. Soc. London, 1911, p. 3 (Tatsienlu, Szechwan, China).

*Specimen*.—One in spirits from Sining, Kansu.

**Genus MINIOPTERUS** Bonaparte

**MINIOPTERUS SCHREIBERSI PARVIPES** G. M. Allen

*Miniopterus schreibersi parvipes* G. M. ALLEN, Amer. Mus. Nov., No. 85, 1923, p. 7 (Yenpingfu, Fukien, China).

*Specimens*.—Eighteen, from the following Fukien localities: 17, including one in spirits, from near Yenpingfu, and one from 70 miles southwest of the same place.

The specimen from the last-mentioned locality is extremely dark—in fact, to such an extent that it stands in considerable contrast to the other skins of the series. The skull is a shade larger than any of the others as well. These are the only differences, however, and it seems that the only sensible thing to do is to pronounce it an extremely large, dark old male of this race. The remainder of the series is entirely uniform. Compared to the typical race of Europe, *parvipes* is slightly larger, especially the forearm, but the foot is no smaller. It is also much darker and more sooty, and the skull averages larger.

**Genus MURINA** Dobson

**MURINA AURATA** Milne-Edwards

*Murina aurata* MILNE-EDWARDS, Rech. Mamm., 1872, p. 250 (Tibet).

*Specimen*.—One from the Likiang Mountains, Yunnan.

This specimen is without collector's measurements, but the forearm has a length of 29 mm.

**MURINA HUTTONI FUSCUS** Sowerby

*Murina huttoni fuscus* SOWERBY, Journ. Mamm., vol. 3, 1922, p. 46 (Imienpo area, Manchuria).

*Specimen*.—One, the type.

It is questionable whether this form should not stand as a full species.

## Order CARNIVORA

### Family URSIDAE

As a basis for identifying Chinese bears one naturally follows the paper by Sowerby,<sup>1</sup> the conclusions in which are eminently sound.

<sup>1</sup>Journ., Mamm., vol. 1, 1920, p. 213-232.

## Genus SELENARCTOS Heude

## SELENARCTOS THIBETANUS MUPINENSIS Heude

*Selenarctos mupinensis* HEUDE, Mems. Hist. Nat. Emp. Chinois, vol. 5, 1901, p. 2 (Muping, Szechwan, China).

*Specimen*.—One from Suifu, Szechwan.

This skin and skull is of a cub so young that it can be allocated solely on geographic grounds, following the supposition that this is really the race of southern Szechwan and *machweilli* the one of the more arid northern part of the province.

## SELENARCTOS THIBETANUS WULSINI A. B. Howell

*Selenarctos thibetanus wulsini* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 115 (Eastern Tombs area, Chihli, China).

*Specimen*.—Four, the type and three topotypes.

I understand that the forests to the east of Peking are rapidly being destroyed. As it is probable that the present race of the black bear is confined to this district it is not unlikely that it will soon be exterminated.

## SELENARCTOS THIBETANUS USSURICUS Heude

*Selenarctos ussuricus* HEUDE, Mems. Hist. Nat. Emp. Chinois, vol. 5, 1901, p. 2 (Ussuri, eastern Manchuria).

*Specimens*.—Two from the region of Imienpo, Manchuria.

These are a fine pair of adult skulls but only that of the female is accompanied by a skin. The latter specimen is the one upon which Sowerby (1920) based a description of this race.

## Genus URSUS Linnaeus

Sowerby, in his review of the bears of eastern Asia (1920), lists the species of cave bear or grizzly type under the generic name *Spelæus*. While the latter is convenient for the purpose of designating group characters of subgeneric degree, I regard it as undesirable to accord it full generic standing. Both of the only two specimens of Chinese brown bears available are of this rather than of the *arctos* type.

## URSUS CAVIFRONS (Heude)

*Melanarctos cavifrons* HEUDE, Mems. Hist. Nat. Emp. Chinois, vol. 5, 1901, p. 1 (Tsitsihar, northwest Manchuria).

*Specimen*.—One from the district of Imienpo, Manchuria.

Ognev (1924) called the Manchurian bear of this group *mandchuricus* Heude, but Sowerby (1920), after examining Heude's types, determined that the latter name applies to the local race of *arctos*. This immense Imienpo male is described by Sowerby and skull measure-

ments are given. The last maxillary molar measures 43 mm. in length and 21.4 in width.

URSUS LEUCONYX Severtzow

*Ursus leuconyx* SEVERTZOW. Nach. Gesellsch. Moskau, vol. 8. 1873. p. 79 (Altai region, Siberia).

*Specimen*.—One from near Taochow, Kansu.

There is nothing in the original description which indubitably places this species in the cave-bear rather than the *arctos* group. Sowerby (1920) assumed that it belonged in the former because of its light-colored claws. In this he was probably correct and his lead in this respect should be followed for the present. Another nomenclatural possibility is *baikalensis* Ognev, which seems to belong to the *Spelaeus* group rather than to *arctos*, as the describer stated. Its type locality is apparently the Irkutsk part of the Sajan Mountains south of Lake Baikal, and it seems likely that it will prove to be synonymous with *leuconyx*. The present specimen is a juvenile but a very large race is indicated and the last upper molar has a length of 40 mm. Although unsatisfactorily comparable, there are apparently no important differences between this skull and one from south of Irkutsk that are not attributable to age. There are indicated, however, external differences that are believed to be of subspecific significance, but because of the tender age of this single example and ignorance of the juvenal pelage of undoubted *leuconyx*, I do not feel justified in making it the basis of a new name. *U. leuconyx* is said to have white claws while those of the Kansu skin are rather dark horn color. The hairs of the entire head are almost black at base but are so extensively tipped with ochraceous that it appears yellow; and the same to a lesser extent is true of the middle and lower back. There is a broad collar of pure white, from 50 to 100 mm. wide, which also extends over the chest and narrowly upon either side almost to the groin. The suggestion of a light collar is found in many races of Asiatic bears of both types and it is known that this is often more pronounced in the young than the adult. But it is not believed that the young of *leuconyx* could be so strikingly marked in this respect while the adult largely lacks any white collar, which from the description seems to be the case. That the markings of the Kansu skin are not individually peculiar is shown by the photograph of a specimen from the same general region, apparently identically marked, which occurs in Frank Wallace's "Big Game of Central and West China"; but whether the latter is of an adult or juvenile is not mentioned.



## Family PROCYONIDAE

## Genus AILURUS F. Cuvier

## AILURUS FULGENS STYANI Thomas

*Ailurus fulgens styani* THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 10, 1902, p. 251 (Yangllupa, Szechwan, China).

*Specimens*.—Two; one from Wachin, Szechwan, and the other believed to be from Tibet.

In the description of this race Thomas stressed only the superior size and certain skull differences from *typicus*. Subsequently (1922) he reported two examples from Yunnan, under the same name, one of which had a black-ringed tail, while both were heavily darkened over the shoulders and withers. This is the condition in the National Museum's Szechwan pelt. In the other, however, this condition is so much intensified, with extensive black areas upon the middle of *all* the hairs, that it is believed to represent a new race. It is a trade skin, however, without skull or definite locality and too many new names have already been based upon such objectionable material.

## Family CANIDAE

## Genus NYCTEREUTES Temminck

## NYCTEREUTES PROCYONOIDES STEGMANNI Matschie

*Nyctereutes stegmanni* MATSCHIE, Wissens. Erg. Exped. Filchner China und Tibet, vol. 10, pt. 1, 1908, p. 180 (Tschonkiang, lower Yangtze).

*Specimens*.—Four; one from the Likiang Plain, Yunnan, two from Suifu, Szechwan, and one from Chinkiang, Kiangsu.

Upon geographical grounds it seems that the Yunnan specimen should be *ovestes*, but there is no white upon the hairs of the tail and but few of them are tipped with black, while the feet are brown instead of black. The dorsal coloration is, however, considerably brighter than what is believed to be typical of *stegmanni*. The Kiangsu skin conforms to Matschie's description very well indeed.

## NYCTEREUTES PROCYONOIDES USSURIENSIS Matschie

*Nyctereutes ussuriensis* MATSCHIE, Wissen. Erg. Exped. Filchner China und Tibet, vol. 10, pt. 1, 1908, p. 178 (near Ussuri, Manchuria).

*Specimen*.—One from northern Manchuria.

This is a large, brightly colored race, with interocular area no darker than the nose.

## Genus VULPES Oken

A number of the races of Asiatic foxes, including all the Chinese ones, are in such a state of confusion and are so little understood

that any determination based on scanty material is all but worthless. The specimens at hand, however, may be tentatively disposed of as follows:

**VULPES VULPES subspecies**

There is in the National Museum a single skin without skull of a red fox of the usual *vulpes* type and rather small which is said to be from Korea. Subspecific allocation is impracticable.

**VULPES VULPES MONTANUS (Pearson)**

*Canis vulpes montanus* PEARSON, Journ. Asiatic Soc. Bengal, vol. 5, 1836, p. 313.

Four trade skins without skulls purchased in the vicinity of the China-Tibet boundary had best be referred to this race. One of them especially is very similar to Kashmir skins; the sides are pale and the pelage considerably worn.

**VULPES VULPES AURANTIOLUTEUS Matschie**

*Vulpes aurantioluteus* MATSCHIE, Wissens. Erg. Exped. Filchuer China und Tibet, vol. 10, pt. 1, 1908, p. 168 (bought in Tatsienlu, Szechwan, China).

*Specimens.*—Two: from Suifu, Szechwan, and Minshan Mountains, Kansu. Without having the material to pass upon the validity of this form, these two specimens are referred to it. The one from Kansu, taken in August and much paler than the other, is considerably paler upon the sides and is presumed to be an immature.

**Genus CUON Hodgson**

**CUON PRIMAEVUS (Hodgson)**

*Canis primaevus* HODGSON, As. Res., vol. 18, 1833, p. 221 (middle region of Nepal, India).

*Specimen.*—One from Tseojiakeo, Szechwan.

This example is very red, like the wild dog of India rather than like the lighter *dukhunensis* of the Himalayas and it seems as though it should certainly be distinct. However, there is no comparative material at hand.

**Family MUSTELIDAE**

**Genus CHARRONIA Gray**

Until 1918 there was no known character for satisfactorily differentiating this group of martens generically, but in that year Pocock indicated characters of the baculum which are entirely sufficient for this purpose.

**CHARRONIA FLAVIGULA BOREALIS (Radde)**

(*Mustela flavigula*) varietas *borealis* RADDE, Reise Süden Ost-Sib., vol. 1, 1862, p. 23 (Amur, Siberia).

*Specimens*.—Eight, one being from each of the following localities: An indeterminate spot in Manchuria; Imienpo, Manchuria; Sianfu, Shensi, and 90 miles west southwest thereof; Taiyuanfu, Shansi; Tseogiakco, Szechwan; and the Salween-Mekong divide in Yunnan.

When sufficient skulls are available it is probable that the north and west China martens may with propriety be resolved into two or more valid forms. The coloration of this species is, however, exceedingly variable and all of the color characters that have been ascribed to the several races named from this area are well within the range of individual variation. Unfortunately, most of the specimens secured are hunters' skins, without skulls or measurements. The two Manchurian pelts differ from each other fully as much as they do from the Shensi individuals and can not be called *koreana*. The one from Shansi is not greatly different from another from Fukien provisionally called *kuatunensis*. The Yunnan skin is very dull colored and that from Szechwan very bright; and they exhibit no characters by which *setchuensis* might be recognized.

CHARRONIA FLAVIGULA KUATUNENSIS (Bonhote)

*Mustela flavigula kuatunensis* BONHOTE, Ann. Mag. Nat. Hist., ser. 7, vol. 7, 1901, p. 348 (Kuatun, Fukien, China).

*Specimen*.—One from 75 miles southwest of Yenpingfu, Fukien.

This identification is but tentative as the validity of the race has not yet been established. The above example differs from true *flavigula* only in the slightly darker underparts.

Genus MUSTELA Linnaeus

MUSTELA NIVALIS MOSANENSIS Mori

*Mustela nivalis mosanensis* MORI, Journ. Chosen Nat. Hist. Soc., 1927, p. 1 (Yengan, near Mosan, northeast Korea).

*Specimen*.—One from 60 miles southwest of Kirin, Manchuria.

This fine skin without skull is markedly smaller (177 by 38 by 24 mm.) than the measurements given by Mori and should not be considered as typical; but it is definitely not *pygmaea*. It is darker than any of the considerable number of true *nivalis* in the national collection and can be matched (and exactly) only by certain skins of the American species *riwosa*.

MUSTELA species

*Specimens*.—Two, from 70 miles northwest of Taiyuanfu, Shansi, and 40 miles west of Sining, Kansu.

These two specimens of small weasels belong to entirely different groups. As there is not a single other comparable specimen in the

National Museum from any portion of Asia I deem it preferable to make no attempt to name them for the present.

**MUSTELA SIBIRICA SIBIRICA Pallas**

*Mustela sibirica* PALLAS. Spicil. Zool., vol. 14, 1780, p. 86 (eastern Siberia).

*Specimens*.—Six: one each from Tientsin and Peking, Chihli; 2 from near Sianfu, Shensi; and 2 from near Taiyuanfu, Shansi.

As with the other weasels, the nomenclature of the Chinese minks is not easy of proper disposition, but the material at hand is adequate to show that it is separable into four races. It is well known that the brown summer pelage of these animals is very different from the bright winter coat. Coloration seems to be quite uniform when one has specimens in similar pelage from a single geographic area. The difficulty is encountered when individuals in changing pelage are to be allocated; and there seems to be some little variation with age.

No undoubtedly typical specimens of *sibirica* are available and it must therefore be presumed that the popular supposition to the effect that Shansi and Shensi material should be so identified is correct. At any rate these skins are separable from the remainder of the specimens on the grounds of pale winter coloration coupled with a minimum of sootiness about the face and no black upon the feet (vs. *manchurica*). A summer skin from Shensi has a darker tail tip, which is not found upon the one from Tientsin.

**MUSTELA SIBIRICA MOUPINENSIS (Milne-Edwards)**

*Putorius moupinensis* MILNE-EDWARDS, Rech. Mamm., 1872, p. 347 (Muping, Szechwan, China).

*Specimens*.—Four from Szechwan; Sungpan, 1, and Suifu, 3.

Although October and December skins are represented these are of the dark summer type of coloration, and the former is very much worn. The tone is dark as in the Manchurian race but there is also a definite darkening of the tail tip and the face is less distinctly sooty.

Barrett-Hamilton gave the type locality of his *Putorius sibiricus noctis* as Sanyentze, China. I can not locate this on any map, but the termination of the name would indicate that it is certainly in Szechwan, and it is hence likely that he described merely the summer pelage of *moupinensis*.

**MUSTELA SIBIRICA DAVIDIANA (Milne-Edwards)**

*Putorius davidianus* MILNE-EDWARDS, Nouv. Arch. Mus., vol. 7, 1870, p. 92 (Kiangsi).

*Specimens*.—Seven, from 20 miles east of Taipingfu, Anhwei, 1; Yochow, Hunan, 4; Futsing, Fukien, 1; and Shanghai, Kiangsu, 1.

It seems probable that the first five of these specimens mentioned are rather typical. These and the Fukien example are in winter pelage, which is much brighter and of a more intense color than occurs in true *sibirica*. The Shanghai skin is in summer pelage, distinctly darker than comparable *sibirica*.

#### MUSTELA SIBIRICA MANCHURICA Brass

*M. (ustula) manchurica* BRASS, Reiche Pelze, 1911, p. 490 (Manchuria).

*Specimens*.—Seven: Seoul, Korea, 4; Imienpo, 1, and 120 miles northeast of Sansing, 2—both localities in Manchuria.

Winter skins of this race are distinguishable from those of Shansi and Shensi *sibirica* by the more sooty face and feet. Summer skins may be told from *sibirica* and *dauidiana* by the darker, richer body color and very dark face. The four Korea skins are juvenal but the two that are in unworn pelage have a peculiar, golden-brown sheen upon the tips of the guard hairs suggestive of some races of beaver (*Castor*).

#### MUSTELA TIARATA Hollister

*Mustela tiarata* HOLLISTER, Proc. Biol. Soc. Wash., vol. 26, 1913, p. 2 (150 miles east of Lanchow, Kansu).

*Specimens*.—Seven, from the following localities in Kansu: 150 miles east of Lanchow, 3 (including the type); 10 miles west of Sining, 1; and 120 miles south of Lanchow, 3.

These are all very uniform and much darker than *lineiventor*.

#### MUSTELA LINEIVENTER Hollister

*Mustela lineiventor* HOLLISTER, Proc. Biol. Soc. Wash., vol. 26, 1913, p. 2 (Little Altai, Siberia).

*Specimens*.—Two from Shansi: Wutsai, one, and a second from an unknown spot.

No Tibetan examples of *larvata* are at hand but these two examples do not conform to the descriptions of that animal. On the contrary they match very well the type series of *lineiventor*. That the latter is but a subspecies seems certain, but whether of the European animal or of *larvata* remains to be established.

### Genus VORMELA Blasius

#### VORMELA NEGANS Miller

*Vormela negans* MILLER, Proc. U. S. Nat. Mus., vol. 38, 1910, p. 385 (Ordos Desert about 100 miles north of Yulinfu, Shensi, China).

*Specimens*.—Two (including the type) skins without skulls from the type locality.

In his field notes Mr. Sowerby stated that this is evidently a rare inhabitant of the Ordos. From what he could learn it must

frequent spots where trees exist and climbs freely, as its native name would signify.

Genus **LUTRA** Brisson

**LUTRA LUTRA** (Linnaeus)

(*Mustela*) *lutra* LINNAEUS. Syst. Nat., vol. 1, ed. 10, 1758, p. 45 (Upsala, Sweden).

*Specimens*.—Two: a broken skull only from Sianfu, Shensi, and the skin only of a juvenile from Fusan, Korea.

Specimens of Chinese otters are still too scarce to be able to determine the status of the names *chinensis* and *hanensis*.

Genus **HELECTIS** Gray

**HELECTIS MOSCHATA** Gray

*Helictis moschata* GRAY. Proc. Zool. Soc. London, 1831, p. 94 (China).

*Specimens*.—Two: Shanghai, Kiangsu, 1, and Yochow, Hunan, 1.

The Shanghai example is without skull. The second skin is somewhat similar save that the underparts are pale ochraceous, this darkening in the inguinal region. The skull shows a much greater zygomatic spread than any other available but it is considerably the oldest, and just this variation with age is at times encountered in the case of certain other carnivores (as *Martes*). For the reason, then, that sufficient is not known regarding the normal variation within this genus the Hunan animal is not named as new, although it is thought probable that this course will prove the desirable one eventually.

**HELECTIS MOSCHATA FERREO-GRISEUS** Hilzheimer

*Helictis ferreo-griseus* HILZHEIMER. Zool. Anz., vol. 29, 1905, p. 298 (bought in Hankow (Hupeh); locality unknown).

*Specimens*.—Four from Szechwan; Kiating, 1; and Suifu, 3.

These four skins, accompanied by but two skulls, conform well to the description of this race, which is probably but subspecifically distinct from *moschata*. It may be noted, however, that the infraorbital foramina of the Kiating skull are larger, and of the single Suifu skull, quite small.

Genus **MELES** Brisson

**MELES LEPTORHYNCHUS** Milne-Edwards

*Meles leptorhynchus* MILNE-EDWARDS. Ann. Soc. Hist. Nat. Paris, vol. 8, 1867, p. 374 (Peking, Chihli, China).

*Specimens*.—Five: Tientsin and Tabul, Chihli, 1 each; Tao River, Kansu, 1; Taiyuanfu, Shansi, 1; and Yochow, Hunan, 1.

These are quite uniform excepting the juvenile from Hunan, which has the white nose-stripe extending only half way between the nose

and eyes, thus having one of the characters upon which *tsingtauensis* was founded. This, however, is variable in this genus and the validity of the latter name, as well as of *hanensis*, is open to question.

**MELES AMURENSIS** Schrenck

*Meles taxus* var. *amurensis* SCHRENCK, Reise Amur-land, vol. 1, 1858, pl. 1 (northern Manchuria).

*Specimens*.—Two from Manchuria—one from the Sungaree River and the other from an unknown locality.

It is probable that *amurensis* is a good race but a dependable description of it seems to be lacking and specimens scarce. The two in hand are allocated by locality alone for one is a mere baby, very dark except for extensive white tipping of the guard hairs and pure white tail, while the other, which is a trade skin without skull and purchased at Tientsin, is very old. The whole dorsum is yellowish white with darker areas near the ends of the guard hairs only along the middorsum.

**Genus ARCTONYX** F. Cuvier

**ARCTONYX LEUCOLAEMUS LEUCOLAEMUS** (Milne-Edwards)

*Meles (Arctonyx) leucolaemus* MILNE-EDWARDS, Rech. Mamm., 1871, p. 195 (Peking, Chihli, China).

*Specimens*.—Four: 80 miles east of Peking, Chihli, 1; Ningpo, Chekiang, 2; and Kuatun, Fukien, 1.

The specimen from Chihli, which is undoubted *leucolaemus*, is rather light about the head and the hairs of the posterior half of the dorsum lack white tips, both of which are characters considered to be individually variable. This is fairly between two skins from Ningpo representing two extremes of head coloration. In one there are hardly any dark markings while in the other the white nose stripe extends only to just above the eyes. This illustrates the rashness of coining new names for such carnivores when material is too scanty for gaining a proper appreciation of the range of individual variation.

**ARCTONYX LEUCOLAEMUS OBSCURUS** Milne-Edwards

*Arctonyx obscurus* MILNE-EDWARDS, Rech. Mamm., 1871, p. 338 ("Chinese Tibet"=Yunnan or extreme southwestern Szechwan).

*Specimens*.—Four; Minshan Mountains, Kansu, 1; Mount Omei, 2, and Washan, 1, both in Szechwan.

I can not see the slightest reason why all the Chinese members of this genus should not be considered as races of a single species. Furthermore, all the external characters, at least of the three forms most recently named—*orestes*, *incultus*, and *milne-edwardsi*—are believed to fall well within the limits of individual variation of these most variable carnivores. In fact, most of these differences occur in

two specimens at hand from Chekiang as already mentioned. As far as actual differences are concerned, one would be justified in identifying all my eight Chinese examples as belonging to one race, but it is believed likely that adequate material would show that the west China animal is distinct. The Kansu pelt is very dark with the extreme proximal portion of the hairs black instead of white. But this example is very young and it is known that juveniles of *Meles* may be considerably darker than adults. The skulls of these specimens are too variable in age to be of much use in the present connection.

## Family VIVERRIDAE

### Genus VIVERRA Linnaeus

#### VIVERRA ZIBETHA ASHTONI Swinhoe

*Viverra ashtoni* SWINHOO, Proc. Zool. Soc. London, 1864, p. 379 (Suykaou, River Min, Fukien, China).

*Specimen*.—One from Futsing, Fukien.

This race has at various times been considered as identical with true *zibetha*. The specimen at hand certainly seems to be sub-specifically distinct from what is evidently typical of the latter and as it is from near the type locality of *ashtoni* it seems wiser to call it that. It does not agree very well either with Swinhoe's poorly executed figure or with his description, probably for the reason that the type was evidently in thin summer coat while the present example is in especially luxuriant winter pelage. Details that may be mentioned consist of the absence of dark barring upon the lower shoulders, the dorsal crest as long and as black as *typicus*, and the pure white rings of the tail.

#### VIVERRA ZIBETHA FILCHNERI Matschie

*Viverra filchneri* MATSCHIE, Wissens, Erg. Exped. Filchner China und Tibet, vol. 10, pt. 1, 1908, p. 192 (Hinganfu, Shensi, China).

*Specimens*.—Six: 2 each from Wachin and Yachowfu, Szechwan; Yochow, Hunan, 1; and Yunnan, 1.

Five of these are hunter's skins without skulls and it is with some hesitation that they are thus identified. They differ slightly from the Fukien pelt of *ashtoni* in being paler upon the sides and in having the incipient spots or wavy lines of the flanks somewhat more distinct. But the Fukien pelt is in heavier pelage than any of the others and the apparent differences may be due only to this fact. The Yunnan skin is of a half grown animal and the pale head and neck markings are mostly gray instead of whitish.



Genus **VIVERRICULA** Hodgson**VIVERRICULA PALLIDA** Gray

*Viverricula pallida* GRAY, Hardwicke's Illust. Indian Zool., vol. 2, 1833, p. 34, pl. 6 (China, probably near Canton, Kwangtung).

*Specimens*.—Four: 2 from Futsing, Fukien; a skeleton only from Nanking, Kiangsu; and 1 from Suifu, Szechwan.

I agree with Allen (1912) in doubting the validity of the race *filchneri* Matschie, as the characters which were ascribed to it are not such as are reliable. The flat skin without skull from Suifu is more ochraceous than that of Fukien, and the tail is not only shorter but the hairs of the dark rings are broadly tipped with brown over the middorsal part. Great variation in color is known to occur in this genus, however.

Genus **PAGUMA** Gray**PAGUMA LARVATA YUNALIS** Thomas

*Paguma larvata yunalis* THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 8, 1921, p. 617 (Yenyuensien, Yunnan, China).

*Specimens*.—Six: 1 from Wahsin and 3 from Suifu, Szechwan; and 2 from an altitude of 10,500 feet in the Likiang Mountains, Yunnan.

The single adult from Szechwan is quite pale and on this character might be referred to the next race. The terminal four-fifths of the tail of the Suifu juvenile is solid black, while that of the Wahsin example, which is equally young, is grayish buffy and without any black at all.

**PAGUMA LARVATA RIVALIS** Thomas

*Paguma larvata rivalis* THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 8, 1921, p. 618 (Ichang, Yunnan, China).

*Specimen*.—One from Yochow, Hunan.

This pelt is more tawny than any others of the genus at hand and the black of the nape is represented merely by a slight sootiness in this region. It is undoubtedly different from the other specimens available and closer to the description of *rivalis*. Whether it is identical with the latter can not be established at this time.

Genus **HERPESTES** Illiger**HERPESTES CANCRIVORA HANENSIS** (Matschie)

*Urva hanensis* MATSCHIE, Wissens. Erg. Exped. Filchner China und Tibet, vol. 10, pt. 1, 1908, p. 190 (Hankow, Hupeh, China).

*Specimens*.—Three: Ningpo, Chekiang, 1; and Futsing, Fukien, 2.

I can see no reason for according *Urva* more than subgeneric rank. About the eye and thence extending to the muzzle of these specimens

there is an area over which the hairs are exceedingly short and rather ochraceous, thus giving to the face a spectacled appearance. In the Fukien examples the white bands extending from the mouth over the shoulders are very distinct. These are less well marked in the Ningpo specimen, and it is appreciably darker above. This race is accepted tentatively but is open to considerable question.

## Family FELIDAE

### Genus FELIS Linnaeus

#### FELIS PARDUS FONTANIERII Milne-Edwards

*Felis fontanierii* MILNE-EDWARDS, Ann. Sci. Nat. Zool., vol. 8, 1867, p. 375 (Peking, Chihli, China).

*Specimens*.—Three: Taiyuanfu, Shansi, 1; Minchow, Kansu, 1; and Yochow, Hunan, 1 skull only.

The Kansu specimen is fine and very large, while the pelt from Shansi is much smaller and probably immature. The latter gives an appearance of being considerably paler, chiefly because the borders of the rosettes are not continuous in outline while those of the other are.

#### FELIS UNCIA Schreber

*Felis uncia* SCHREBER, Saug., vol 3, 1778, p. 386, pl. 100.

A fine native skin without skull was purchased by Dr. W. L. Abbott. The locality was said to be Tibet. It is probably in spring pelage as although this is full, it is somewhat worn. The coloration tends toward ochraceous more than seems to be usual in this animal.

#### FELIS NEBULOSA Griffith

*Felis nebulosa* GRIFFITH, Descript. Vert., 1821, p. 37.

*Specimen*.—One skin only, from Kachek, Hainan.

This flat hunter's skin, somewhat torn and with part of the tail missing, is the first clouded leopard reported from Hainan since 1870 (Swinhoe) and is of the paler, ochraceous type. The material is not available to judge of the degree of resemblance of this example to typical *nebulosa*.

#### FELIS TRISTIS Milne-Edwards

*Felis tristis* MILNE-EDWARDS, Rech. Mamm., 1871, p. 223 (China).

A beautiful hunter's skin without skull of this exceedingly rare cat was bought by D. C. Graham at Tatsienlu, Szechwan. One can not tell the degree to which the skin has been stretched during tanning, but this specimen, especially the tail, seems to be definitely larger than what is supposed to be true *tristis*. It will be referable to *semenovi* if this be really distinct from *tristis*, but the type locality

of the latter is unknown, being merely China, and until series have become available conservatism must be employed.

**FELIS TEMMINCKI DOMINICORUM** Sclater

*Felis dominicorum* SCLATER, Proc. Zool. Soc. London, 1898, p. 1 (Foochow, Fukien, China).

*Felis (Catopuma) melli* MATSCHIE, Archiv Naturgesch., vol. 88, 1922, p. 36 (Not *Felis (Neofelis) melli* Matschie).

*Felis temmincki badiodorsalis* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 39, 1926, p. 143 (New name for *Felis (Catopuma) melli* Matschie).

*Specimen*.—One from Fukien.

By an unfortunate oversight the name *dominicorum*, listed in the Addenda of Trouessart, was overlooked by me at the time I first endeavored to identify cats of the *temmincki* group. Hence the name *badiodorsalis*, which I suggested to replace the preoccupied name *melli*, must be placed in synonymy, for it is unlikely that there are any tangible differences in cats representative of the above names. The specimen recorded is without date or measurements and the skull is damaged.

**FELIS EUPTILURA** Elliot

*Felis euptilura* ELLIOTT, Proc. Zool. Soc. London, 1871, p. 760 (type locality unknown).

*Specimens*.—Three: Chenkiang, Kiangsu, 1; Hsinglungshan, Chihli, 1; and Korea, 1. ·

The Kiangsu and Chihli specimens are in winter coat and are almost identical, with ground color grayish and the bay spots illy defined. The Korean example, on the other hand, is evidently in summer pelage and is markedly ochraceous, which is just such a seasonal difference as one would expect.

**FELIS BENGALENSIS** Kerr

*Felis bengalensis* KERR, Linn. Anim. Kingd., 1792, p. 151 (India).

A skin with skull, presented by Dr. W. L. Abbott and marked "Chinese Turkestan, possibly Tibet" is indistinguishable from the larger, buffier specimens of this animal from India. It is deemed likely that at least most of the small Chinese cats of this general type, such as *scripta* on the one hand and *chinensis* on the other, will eventually be found to bear a subspecific relationship to this form. It also seems possible that there may be a blending of characters between *chinensis* and *euptilura*, but hardly between the latter and *scripta*. For the present, the binomial may be used for all these cats.

**FELIS SCRIPTA** Milne-Edwards

*Felis scripta* MILNE-EDWARDS, Nouv. Arch. Mus. Hist. Nat., vol. 7, 1871, p. 92 (Muping, Szechwan, China).

*Specimens*.—Seven, Suifu, Szechwan, 6; and Likiang Mountains at 10,000 feet, Yunnan, 1.

The Yunnan specimen is quite a bit different from the others, as the larger spots are broken up into smaller ones, and there are darker, more tawny or "tabby" areas throughout the buff. It is slightly smaller than the average domestic cat, and the possibility of it being a cross with that animal is worth considering. No skull of *ingrami* was available when this name was proposed by Bonhote and I consider it rather likely that the type of the latter may have been a young individual of *scripta*.

**FELIS CHINENSIS Gray**

*Felis chinensis* GRAY, Mag. Nat. Hist., vol. 1, 1837, p. 577 (China).

*Specimen*.—One from Yenanku, Shensi.

This example is in heavy winter coat with dorsal marks darker and better defined than in the specimens assigned to *euphilura*.

## Order PRIMATES

### Family CERCOPITHECIDAE

#### Genus PITHECUS Geoffroy and Cuvier

##### PITHECUS THIBETANUS (Milne-Edwards)

*Macacus thibetanus* MILNE-EDWARDS, Compt. Rend., vol. 70, 1870, p. 341 (mountains near Muping, Szechwan, China).

*Specimens*.—Three from Mount Omei, Szechwan.

This lot consists of a fine male, female, and young. The male is almost black above, smoky brown below, and there is much gray grizzling about the face. The female lacks the latter detail and is browner. The tail in this species is very short and, as seems usual in the large, short-tailed macaques, the posterior nares are relatively very narrow and high. From the descriptions it seems not unlikely that these specimens may be somewhat darker than typical.

##### PITHECUS PULLUS A. B. Howell

*Pithecus pullus* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 41 (Kuatun, Fukien, China).

*Specimen*.—One, the type.

This large, short-tailed macaque is related to *P. thibetanus* but is uniformly of a chocolate color with the suggestion of a golden sheen. Its recent discovery in a spot mammalogically so historical as Kuatun indicates the richness of the fauna of this region.

**PITHECUS LASIOTIS (Gray)**

*Macacus lasiotis* GRAY, Proc. Zool. Soc. London, 1868, p. 61 (Szechwan, China).

*Specimens*.—Ten: Chihli, 2; Shanghai, Kiangsu, 3; Mount Omei, 1. Giakeoho, 1, and Suifu, Szechwan, 1; and Ashi, Yunnan, 2.

The Kiangsu specimens are in worn pelage, those from Yunnan very bright, and the remainder duller. The material, however, is entirely inadequate to enable one to judge of the proper disposition of the names *tcheliensis* and *vestitus* and as the matter is further complicated by ignorance regarding just which of the specimens were transported captives, the more conservative nomenclature is herewith employed.

**Genus PYGATHRIX Geoffroy****PYGATHRIX species**

*Specimens*.—Three: purchased in Peking and said to be from Eastern Tombs, Chihli, 1; and bought alive in Shanghai, Kiangsu, 2.

I am not aware that the present genus has been recorded from northern China and it seems extremely likely that the Chihli specimen was brought into the country from elsewhere. It is a young individual, the chin and throat being white and the rump and base of the tail distinctly paler gray than the rest of the back, suggesting *P. nigripes* of Cochin China. On the labels of the two bought alive in Shanghai by Mr. Wulsin is written "Hainan." but it seems most unlikely that they came from this island. The locality of capture therefore is unknown and their characters do not permit of exact determination with the comparative material available. The dorsum is black while the facial markings, shoulder stripes and underparts are dingy gray. There is also a preponderance of these gray hairs upon the hind legs and beneath the tail.

**Genus RHINOPITHECUS Milne-Edwards****RHINOPITHECUS ROXELLANAE (Milne-Edwards)**

*Semnopithecus roxellanae* MILNE-EDWARDS, Compt. Rend., vol. 70, 1870, p. 341 (principality of Moupin, Tibet=Muping district, Szechwan, China).

The single hunter's skin, without skull, of an adult female of this interesting and rare monkey was purchased by Doctor Graham from natives in southern Szechwan. He said in his field catalogues that its habitat is said to be in the high mountains north and west of Yachow.

## Order RODENTIA

### Family SCIURIDAE

#### Genus MARMOTA Blumenbach

The Asiatic marmots are in a condition far from orderly and but little can be done with them until much material has been studied.

#### MARMOTA BOBAC SIBIRICA (Buchner)

*A (rectomys) bobac* var. *sibirica* BUCHNER, Mamm. Przewalski, 1888, p. 39 (south Russia).

*Specimens*.—Four skulls without skins from north Urga, Mongolia.

#### MARMOTA CENTRALIS (Thomas)

*Arctomys centralis* THOMAS, Ann. Mag. Nat. Hist., ser. 8. vol. 3, 1909, p. 260 (Mt. Borocho, northern Sinkiang).

*Specimen*.—One from near the Kobdo River, Mongolia.

This example was so identified by the late N. Hollister. It matches the description of *centralis* but no attempt is made to pass upon the relationship of this form.

#### MARMOTA HIMALAYANA HIMALAYANA (Hodgson)

*Arctomys himalayanus* HODGSON, Journ. Asiatic Soc. Bengal., vol. 10, 1841, p. 777 (Tibet).

*Specimen*.—One from Dytschyu (=Dzachu?), Tibet.

This single specimen is comparable in every way with the lighter examples of a series from Ladak.

#### MARMOTA HIMALAYANA ROBUSTA (Milne-Edwards)

*Arctomys robusta* MILNE-EDWARDS, Nouv. Arch. Mus., vol. 7, 1870, p. 92 (Muping, Szechwan, China).

*Specimens*.—Thirteen: 1 from Nganyangba, Szechwan, and the remainder from Kansu as follows: Taochow, 7; 100 miles southwest of Lanchow, 3; and Archuen, Minshan Mountains, 1.

It is not known for certain that this race is distinct. G. M. Allen (1912) followed de Winton and Styan in considering it as inseparable from *himalayana*, but the latter authors did not recognize many races of other genera which according to present day usage are considered to be excellently differentiated. The material at my disposal is undoubtedly representative of *robusta* as such and it is believed that the differences shown, consisting chiefly of the greater amount of black in the pelage, especially on and about the tail, are sufficient for subspecific recognition.

## Genus CITELLUS Oken

## CITELLUS DAURICUS MONGOLICUS (Milne-Edwards)

*Spermophilus mongolicus* MILNE-EDWARDS, Ann. Sci. Nat., vol. 7, 1867, p. 376 (northwest Chihli, China).

*Specimens*.—Thirty-two: near Peking, 1, Tientsin, 4, Tabul, 4, and west of Lamamiao, 6—the foregoing in Chihli; Tungkwan, 1, and vicinity of Sianfu, Shensi, 1; Lanchowfu, 12, and Chingningchow, Kansu, 3.

G. M. Allen (1925) stated "specimens obtained—near Peking are therefore topotypes," but this is slightly misleading for Thomas (1908) had already fixed the type locality for this animal as Suanhwafu, Chihli, some 90 miles northwest of Peking. There is great variation in this type of ground squirrel, this apparently being due chiefly to age and to a lesser extent to season. In the skins before me there is fully as much individual as geographic variation, with the palest individual and one of the darkest from the same locality. Hence there is no choice but to call them all the same thing.

## CITELLUS EVERSMANNI EVERSMANNI (Brandt)

*Spermophilus eversmanni* BRANDT, Bull. Acad. Imp. Sci. St. Petersb., vol. 9, 1841, p. 43.

*Specimen*.—One from the Tianshan Mountains, Sinkiang.

## Genus DREMOMYS Heude

## DREMOMYS PERNYI PERNYI (Milne-Edwards)

*Sciurus pernyi* MILNE-EDWARDS, Rev. Zool., vol. 19, 1867, p. 230 (Szechwan, China).

*Specimens*.—Nine from Yunnan: From 9,500 to 12,000 feet, Likiang Mountains, 4; Hofuping Mountains, Mekong Valley, 3; Yangtze Mountains, 1; and Chuchi, 1.

The Hofuping and Yangtze Mountain specimens are undoubtedly fairly representative of the typical race of this species but examples from the same locality exhibit appreciable variation in the degree of buffness shown. The Chuchi skin has a strong overwash of ochraceous upon the whole medial side of the thigh, although the throat is white. It does not approach *howelli*, *mentosus*, or *imus*, and merits separation if the characters which it exhibits should prove to be uniform. The Likiang specimens listed under this race cannot be identified as *lichiensis*, for they are distinctly too gray and close to *pernyi*. Three of them are excessively worn dorsad. The race *lichiensis* may be invalid or there may have been a recent infusion of individuals of the typical race into a part of these mountains, if the surrounding topography renders this a possibility. G. M.

Allen (1925) noted that his specimens from the Likiang Range were barely distinguishable from *griselda*, rather than more yellowish olivaceous than *flavior*, as stated by the describer of *lichiensis*, so it is evident that his specimens are also of the grayer type which I have referred to *pernyi*.

**DREMOMYS PERNYI CALIDIOR** Thomas

*Dremomys pernyi calidior* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 17, 1916, p. 394 (Kuatun, Fukien, China).

*Specimens*.—Two from Kuatun, Fukien.

The bases of the ear patches of these topotypes can hardly be described as white, as mentioned by Thomas. In fact they are but little lighter than the ochraceous color upon the tips of the hairs.

**DREMOMYS PERNYI FLAVOR** G. M. Allen

*Dremomys pernyi flavior* G. M. ALLEN, Proc. Biol. Soc. Wash., vol. 25, 1912, p. 178 (Meutsch, Yunnan, China).

*Specimens*.—Eight from Hwangtsaopa, Kweichow.

These are all September specimens. In addition to the buffy underparts, most strongly marked upon the throat, chest, and in the inguinal region, the cheeks have a strong undertone of ochraceous, as has the undertail. The ruddy anal area is situated well caudad and extends markedly down the medial side of the thighs. The skins seem to be not quite typical and are from fairly midway between the type localities of *modestus* and *flavior*; but their size, as well as the character of pelage, places them with the latter race.

**DREMOMYS PERNYI GRISELDA** Thomas

*Dremomys pernyi griselda* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 17, 1916, p. 392 (Nagchuka, Szechwan, China).

*Specimen*.—One from Damala Pass, Szechwan.

The clear gray of the undertail is characteristic of this race.

**DREMOMYS PERNYI LICHIENSIS** Thomas

*Dremomys pernyi lichienensis* THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 10, 1922, p. 463 (Likiang Range, Yunnan, China).

*Specimens*.—Three from Likiang Mountains, Yunnan.

Variation among the squirrels of this genus occurring in northwestern Yunnan has never been well understood. Several mistakes in identification are known to have been made in the past and undoubtedly others remain undetected. For one thing it is felt that seasonal variation and possibly age differences are not well understood. Under ordinary circumstances it would be considered that



this name should be placed in synonymy, for two subspecies of one species are herein assigned to this one mountain range—a procedure which seldom conforms to good usage. But in other instances the evidence is rather conclusive that two subspecies may occur on different slopes of this mountain range. Because there is so much variation among the Likiang *Dremomys*, then, the race *lichiensis* may possibly prove to be untenable. If it is valid, however, then these two specimens are the only ones among those at hand that may be assigned to it. They were taken in April and July and are very buffy, with the anal patch of large extent and the postauricular areas conspicuous.

**DREMOMYS RUFIGENIS LENTUS A. B. Howell**

*Dremomys rufigenis lentus* A. B. HOWELL, Journ. Wash. Acad. Sci., vol. 17, 1927, p. 80 (near Wenchuanshein, Szechwan, China, at 6,000 feet altitude).

*Specimen*.—One, the type.

This race is based upon the uniformity of coloration of the flanks, back and cheeks. The rufous of the underparts is confined to the chin and upper lips, anal region, and faintly along the inner margin of the hind legs. The postauricular spots are buffy.

**Genus SCIUROTAMIAS Miller**

**SCIUROTAMIAS DAVIDIANUS DAVIDIANUS (Milne-Edwards)**

*Sciurus davidianus* MILNE-EDWARDS, Rev. Zool., vol. 19, 1867, p. 190 (Peking, Chihli, China).

*Specimens*.—Twenty seven: Hsinlungshan, 2, Wulingshan, 2, Chingwangtao, 11, and 15 miles west of Peking, 1—the foregoing in Chihli; mountains northwest of Taiyuanfu, 9, and mountains 10 miles south of Wutai, Shansi, 1; and 15 miles east of Yen-anfu, Shensi, 1.

The Shensi example varies toward *owsteni*.

**SCIUROTAMIAS DAVIDIANUS OWSTENI J. A. Allen**

*Sciurotamias owsteni* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 428 (Taipeishan, Shensi, China).

*Specimens*.—Fourteen: Luitsuen, near Sianfu, 4; near Chingchientshein, 2; and Taipeishan district, 80 miles west-southwest of Sianfu, 3—the foregoing in Shensi: the following in the province of Szechwan—Wenchuen, 1; Sungpan, 2; and Ludinchiao, 1. And one from Hwangtsaopa, Kweichow.

One from near Chingchientshein varies toward typical *davidianus*. Than the latter this race is a trifle larger with brighter, browner back, tail and feet, more richly colored underparts, and there is a strong suggestion of white striping extending caudad from the ears.

Genus *EUTAMIAS* Trouessart*EUTAMIAS ASIATICUS ALBOGULARIS* J. A. Allen

*Eutamias albobularis* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 429 (Taipeishan, Shensi, China).

*Specimens*.—Two from Kansu, probably from the neighborhood of Choni.

These are juveniles but are easily distinguishable from *intercessor* of the same province by the distinctness of the five dark dorsal stripes and by the buffy, almost yellow underparts.

*EUTAMIAS ASIATICUS INTERCESSOR* Thomas

*Eutamias asiaticus intercessor* THOMAS, Abst. Proc. Zool. Soc. London, 1908, p. 44 (Ningwufu, Shensi, China).

*Specimens*.—Twenty: Mountains 30 miles west of Kueihuacheng, Shansi, 1; Lanchow, 10; and Chingningchow, Kansu, 9.

One of the specimens from Chingningchow was compared by Miller with the type and pronounced entirely typical. Hence there is no question of the identity of the present series. This race was said by Thomas to be intermediate in general tone between *senescens* and *ordinalis* but I find it duller and darker even than the former. The rump is less bright, head grayer, stripes blacker, and foot larger. The Kueihuacheng specimens are tentatively placed here as they more closely resemble this form than any other. The shoulders are very gray, face markings bright, and the lighter dorsal stripes particularly whitish.

*EUTAMIAS ASIATICUS ORDINALIS* Thomas

*Eutamias asiaticus ordinalis* THOMAS, Abst. Proc. Zool. Soc. London, 1908, p. 44 (Yulinfu, Shansi, China).

*Specimens*.—Seventeen: 50 miles northwest of Sianfu, 1, and Yulinfu, Shensi, 1; 30 miles west of Linghsien, 1, and from 18 to 95 miles west of Taiyuanfu, Shansi, 13; and the vicinity of Chingningchow, Kansu, 1.

This is a very pale race. The single specimen from Kansu is indistinguishable from the topotype, although other specimens from this vicinity are unquestionably *intercessor*. Most of the Shansi examples are not typical and the only way in which they can be distinguished from *senescens* is by the grayer nuchal region and paler, less rufous sides. In his notes Mr. Sowerby writes that in Shansi and Shensi these active creatures are to be found everywhere, living as they do in woods, in loess gullies and even in stony river beds. They depend mostly on the cultivated fields for their food but he has found their pouches filled with the seeds of grass

and various other plants. In some places the wild jujube affords them a plentiful autumn harvest.

**EUTAMIAS ASIATICUS ORIENTALIS (Bonhote)**

*Tamias orientalis* BONHOTE, Ann. Mag. Nat. Hist., ser. 7, vol. 4, 1899, p. 385 (Upper Ussuri River, Siberia).

*Specimens*.—Twenty-four: 120 miles up the Yalu River, in Korea, 1, and the following localities in Manchuria—60 miles southwest of Kirin, 3; 120 miles northeast of Sansing, 10; 20 to 35 miles south-southeast of Chaoyangchen, 5; Imienpo, 4; and 180 miles up the Yalu River, 1.

Practically all of the individuals listed may be regarded as fairly typical save that a few are inclined to have the rump duller. The Korea specimen is unusually bright, especially upon the head, and the other Yalu River skin is in much worn pelage, showing practically no bright coloring whatever.

Thomas (1908) considered that the races of *E. asiaticus* and *E. senescens* belong to a single species, while G. M. Allen (1925) considered them distinct. Certainly typical specimens of true *asiaticus* and *senescens* are very different looking, but some individuals of *orientalis* and *intercessor*, although differing in tone, have so much in common as regards character of striping, that I am inclined to agree with Thomas.

**EUTAMIAS ASIATICUS SENESCENS Miller**

*Eutamias senescens* MILLER, Proc. Acad. Nat. Sci. Phila., 1898, p. 349 (Western Hills, 15 miles west of Peking, Chihli, China).

*Specimens*.—Eight from Chihli: The type; Chingwangtao, 1; and 65 to 75 miles northeast of Peking, 6.

**EUTAMIAS ASIATICUS UMBROSUS A. B. Howell**

*Eutamias asiaticus umbrosus* A. B. HOWELL, Journ. Wash. Acad. Sci., vol. 17, 1927, p. 80 (140 miles south of Lanchowfu=vicinity of Archuen, Minshan Mountains, Kansu, China).

*Specimens*.—Four: From the type locality (the type) and vicinity, 2; and Sungpan, Szechwan, 2.

This is a dark-colored chipmunk differing from *intercessor*, its nearest ally, in the absence of gray hairs throughout the darker areas of the head and shoulders. The coloration of the head is darker and duller and the gray tips to the hairs upon the upper side of the tail practically hide any ochraceous markings.

**Genus TAMIOPS J. A. Allen**

**TAMIOPS MACCLELLANDI FORRESTI Thomas**

*Tamiops maritimus forresti* THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 5, 1920, p. 305 (Likiang Mountains, Yunnan, China).

*Specimens.*—Two from Yunnan: Yangtze Valley at 10,000 feet altitude, 1; and the north slope of the Likiang Range, 1.

Although the Likiang example was taken during the last of April it has the three dark stripes more usual in summer skins of this genus. The precise locality of capture for the second specimen is unknown, but except for its worn pelage with but the one dark stripe characteristic of late winter, it matches the Likiang skin so well that I have no hesitancy in placing the two together. This is evidently the most olivaceous of all the west China races of *Tamiops*.

**TAMIOPS MACCLELLANDI HAINANUS** J. A. Allen

*Tamiops macclellandi hainanus* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 22, 1906, p. 476 (Leimuimon Hainan, China).

*Specimen.*—One from Kachek, Hainan.

This skin is without measurements, and the skull is precisely intermediate in size between *hainanus* and *riudoni* as listed by Allen. Comparison with typical skins, however, shows that this example belongs to the former race.

**TAMIOPS MACCLELLANDI MARITIMUS** (Bonhote)

*Sciurus macclellandi maritimus* BONHOTE, Ann. Mag. Nat. Hist., ser. 7, vol. 5, 1900, p. 51 (Foochow, Fukien, China).

*Specimens.*—Six from 70 miles southwest of Yenpingfu, Fukien.

These specimens were secured in late November and December and although the difference in coloration from *monticola* is not greater than is the range of seasonal variation within this group it is of a different quality. The characters exhibited are those ascribed to this race and while they were taken only 70 miles from the locality of capture of the *monticola* series they were secured at a considerably lower elevation.

**TAMIOPS MACCLELLANDI MONTICOLA** (Bonhote)

*Sciurus macclellandi monticola* BONHOTE, Ann. Mag. Nat. Hist., ser. 7, vol. 5, 1900, p. 52 (Chingfengling, Fukien, China).

*Specimens.*—Seven from near Yenpingfu, Fukien.

These examples were taken in April and the pelage is full, unworn, and of a rather warm tone.

**TAMIOPS MACCLELLANDI RUSSEOLUS** Jacobi

*Tamiops macclellandi russcolus* JACOBI, Abhandl. Ber. Bus. Tierk. Volkerk. Dresden, vol. 16, 1923, p. 11 (Tsalila near Atenstze, southeast Tibet).

*Specimens.*—Twelve: Tsarong, Tibet, 1; Sila Mountains, 1, and Hofuping Mountains, Yunnan, 10.

The disposition of this material is unsatisfactory and admittedly makeshift. In the first place Jacobi's description is not particularly

illuminating, but his character of the shoulders and lower portion of the back being suffused with tawny-ochraceous fits some of my specimens. All of these skins, possibly with the exception of two, were taken in November, and yet the variation is so marked that extremes might be presumed to represent two well-marked races. There are skins, however, showing merging of characters to different degrees, and sufficient is not yet known regarding the seasonal and age variation of the *Tamiops* to make me willing to describe a new race based upon any of these specimens. In the brighter examples the dorsum shows much ochraceous tawny, the more lateral pale stripes are strongly ochraceous, and there is but a single dark stripe, which is very short. At the other extreme is a grayish tone of pelage, but with the head as ochraceous as in the opposite "phase" of pelage. These have three dark dorsal stripes that are almost black, and the lateral light stripes are buffy, sharply marked, and very broad.

**TAMIOPS MACCLELLANDI SWINHOEI (Milne-Edwards)**

*Sciurus macclellandi swinhoei* MILNE-EDWARDS, Rech. Mamm., 1874, p. 308 (Muping, Szechwan, China).

*Specimens*.—Two from Szechwan: Wenchwan, 1, and Washan, 1.

These summer skins, with the three black dorsal stripes normal to the pelage of this season, are quite typical, and the paler stripes are much more strongly ochraceous than in any other race.

**TAMIOPS CLARKEI Thomas**

*Tamiops clarkei* THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 5, 1920, p. 304 (Yangtze Valley, northern Yunnan, China).

*Specimen*.—One from 8,000 feet upon the east slope of the Likiang Mountains, Yangtze Gorge, Yunnan.

This specimen is very distinctive. There is no date of capture but the dark dorsal stripes are sharply contrasting and there is an additional pair laterally that are almost as dark as the others. The tips of the caudal hairs are whitish, rather than ochraceous, and the subauricular stripes are pure white.

**TAMIOPS VESTITUS Miller**

*Tamiops vestitus* MILLER, Proc. Biol. Soc. Wash., vol. 28, 1915, p. 115 (65 miles northeast of Peking, Chihli, China).

*Specimens*.—Fourteen from Chihli: 80 miles east of Peking (Eastern Tombs), 2; and Hsinglungshan, 65 miles northeast of Peking, 12 (including the type).

This form is so distinct that I regard it as very doubtful whether it intergrades with any race of *macclellandi*. Winter skins have the lateral stripes dull and almost like the flanks, whereas in summer

skins these lines are almost black. This seasonal variation is, of course, usual in most if not all members of this genus.

#### Genus SCIURUS Linnaeus

I do not consider that *Callosciurus* is sufficiently well marked to merit full generic standing, and so include the bay-bellied squirrels of China under the genus *Sciurus*.

#### SCIURUS ERYTHRAEUS BONHOTEI Robinson and Wroughton

*Sciurus castaneiventris bonhotei* ROBINSON and WROUGHTON, Journ. Fed. Malay States Mus., vol. 4, 1911, p. 234 (Szechwan).

*Specimens*.—Nine from Szechwan: Ludin, 1; Mount Omei, 5; Suifu, 1; and Kiating, 2.

These skins are not uniform or precisely typical of this race for there is a strong tendency toward black toes; but they are nearer this than any other form. The ears are like the back, there is a suggestion of barring upon the tail, and the bay color of the underparts is dark in tone.

#### SCIURUS ERYTHRAEUS CASTANEOVENTRIS Gray

*Sciurus castaneiventris* GRAY, Ann. Mag. Nat. Hist., ser. 1, vol. 10, 1842, p. 263 (China).

*Specimens*.—Four: Kaehek, Hainan, 1, and 1 each from Kushan, Peiliang, and Foochow, Fukien.

These skins are quite typical of this race as now understood. Thomas considers that Hainan examples, named *insularis* by J. A. Allen, are indistinguishable from mainland specimens.

#### SCIURUS ERYTHRAEUS GLOVERI (Thomas)

*Callosciurus castaneiventris gloveri* THOMAS, Journ. Bombay Nat. Hist. Soc., vol. 27, 1921, p. 502 (Nagchuka, Szechwan, China).

*Specimens*.—Two from Szechwan: Nagchuka, 1, and Mili, 1.

The single topotype is paler above than any specimen of this group at hand, the ears are strongly ochraceous, the toes are not black, and the intense rufous of the underparts, including the throat, is in sharp contrast to the gray of the chin. The dark zones of the caudal hairs do not form noticeable blackish tail bars and the tail becomes strongly ochraceous toward the tip. On the whole the Mili specimen is closest to this form but it exhibits an interesting variation showing the influence of other characters, as blackish toes, more ochraceous dorsum, and grayer, lightly banded tail.

#### SCIURUS ERYTHRAEUS GORDONI Anderson

*Sciurus gordonii* ANDERSON, Proc. Zool. Soc. London, 1871, p. 140 (Bahmo, eastern Burma).

*Specimens*.—Two from Yunnan; Chuchi, 1, and Linchiafu, 1.

Typical *gordoni* is known to vary to an unusual amount, but there is only one specimen from the type locality available for comparison—a light individual with pale underparts. The Chuchi example is very different, the dorsal coloration, especially of the tail, being very much browner as well as darker, and the belly a more intense shade of bay. It has, however, a midventral stripe of the same color as the back and on the whole had better be referred to *gordoni*. The midventral line is almost obliterated in the Linchiafu skin but it is otherwise similar to the one from Chuchi.

**SCIURUS ERYTHRAEUS HAEMOBAPHES G. M. Allen**

*Sciurus erythraeus haemobaphes* G. M. ALLEN, Proc. Biol. Soc. Wash., vol. 25, 1912, p. 177 (Chihping=Shihping, Yunnan, China).

*Specimens*.—Three from the Hofuping Mountains, Mekong Valley, Yunnan.

It is with considerable hesitancy that these squirrels, from so far northwest of the type locality of *haemobaphes*, are assigned to this race. They certainly should not be presumed to be entirely typical but every character of this form is present, though modified to some extent by *michianus* influence. Presumably squirrels of the *haemobaphes* type have entered the region of northwestern Yunnan by way of the Mekong Valley. It may be mentioned that this was first described as a small race but the given condylobasilar length of 48 mm., equal to a total length of about 55, is above the average of the Chinese squirrels of this group.

**SCIURUS ERYTHRAEUS MICHIANUS Robinson and Wroughton**

*Sciurus castanoevcentris michianus* ROBINSON and WROUGHTON, Journ. Fed. Malay States Mus., vol. 4, 1911, p. 234 (Likiang, Yunnan, China).

*Specimens*.—Six from the Likiang plain, Yunnan.

These seem to be fairly typical except for the fact that there is a suggestion of blackness upon the toes.

**SCIURUS ERYTHRAEUS STYANI Thomas**

*Sciurus styani* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 13, 1894, p. 363 (probably Kaling, Kiangsu, China).

*Specimen*.—One from Kiukiang, Kiangsu.

This seems to be a perfectly typical specimen, with very pale underparts.

**SCIURUS VULGARIS CHIHLIENSIS Sowerby**

*Sciurus vulgaris chihliensis* SOWERBY, Ann. Mag. Nat. Hist., ser. 9, vol. 7, 1921, p. 253 (Wulingshan, 75 miles northeast of Peking, Chihli, China).

*Specimen*.—One—the type.

**SCIURUS VULGARIS COREAE Sowerby**

*Sciurus vulgaris coreae* SOWERBY, Ann. Mag. Nat. Hist., ser. 9, vol. 7, 1921, p. 252 (Kaloguai, 55 miles northeast of Seoul, Korea).

*Specimens*.—Four from Seoul, Korea.

These are summer and early fall examples.

**SCIURUS VULGARIS MANTCHURICUS Thomas**

*Sciurus vulgaris mantchuricus* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 4, 1909, p. 501 (Khingan Mts., Manchuria).

*Specimens*.—Four: Urga district, Mongolia, 1; Fengtien, 1, and Imienpo, Manchuria, 2.

The Manchurian skins, taken in June, September, and October, have but little brownish tinge dorsad. That from Mongolia is a winter example and totally without brown. The white of its underparts seems to extend quite to the anus, which it does not do in the Manchurian skins.

**SCIURUS CANICEPS CANIGENUS A. B. Howell**

*Sciurus caniceps canigenus* A. B. HOWELL, Journ. Wash. Acad. Sci., vol. 17, 1927, p. 81 (Haiyehsien, Hangchow Bay, Chekiang, China).

*Specimens*.—Five from Chekiang: Kangpu near Hangchow, 2; and Haiyehsien, Hangchow Bay, 3 (including the type).

The occurrence of a representative of this species in this part of China is of considerable interest. Average measurements of the above five individuals are, head and body, 198; tail, 143; hind foot, 48.4; ear, 20.7; and skull, 50.3 mm.

**Genus RATUFA Gray****RATUFA GIGANTEA HAINANA J. A. Allen**

*Ratufa gigantea hainana* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 22, 1906, p. 472 (Chetieriang, Hainan, China).

The single flat skin with skull at hand is without definite locality but was received from S. F. Light with a small collection of mammals from Hainan only.

**Genus TROGOPTERUS Heude****TROGOPTERUS EDITHAE Thomas**

*Trogopterus edithae* THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 11, 1923, p. 658 (Northwest flank of the Likiang Mountains, Yunnan, China).

*Specimen*.—One from Washan, Szechwan.

This individual, of which the skin and skull are both imperfect, is immature (the hind foot measures 58 mm.) and the teeth are entirely unworn. The first upper tooth is deciduous, as is indicated by the vacuity beneath its root, and is hardly broader (3.3 mm.)



than the molars, and but little longer (4.5). The tooth pattern is entirely comparable to that given for an animal of this genus by Heude,<sup>2</sup> that being of a young specimen also. As this is the only representative of the genus in the National collection it was sent to Mr. Thomas, who pronounced it typical of this species.

### Genus PETAURISTA Link

#### PETAURISTA CLARKEI Thomas

*Petaurista clarkei* THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 10, 1922, p. 396 (Mekong Valley, Yunnan, China).

*Specimens*.—Three from Tsehchung, Yunnan.

This squirrel has the hairs slaty at base, tipped upon the body with cream, and upon the parachute with rufous. Below the pelage is buffy, darkening to ochraceous on the parachutes. The head is pale gray, the tail tip black, and the feet rufous.

#### PETAURISTA RUBICUNDUS A. B. Howell

*Petaurista rubicundus* A. B. HOWELL, Journ. Wash. Acad. Sci., vol. 17, 1927, p. 82 (Mapientung, Szechwan, China).

*Specimen*.—One—the type.

This squirrel has the underparts light but bright rufous, face, chin, sides of neck and feet darker rufous, and hairs of the remainder of the body appearing to be broadly tipped with the same color, although closer inspection shows that the end of the guard hairs are black. The tip of the tail is also black.

#### PETAURISTA SULCATUS A. B. Howell

*Petaurista sulcatus* A. B. HOWELL, Journ. Wash. Acad. Sci., vol. 17, 1927, p. 82 (Hsinlungshan, 65 miles northeast of Peking, Chihli, China).

*Specimens*.—Three from Chihli: Hsinlungshan, 2 (including the type); Eastern Tombs, 1.

This is a squirrel of the *xanthotis* type of dull coloration but considerably smaller. The maxillary incisors are very broad and each with a well-defined groove.

#### PETAURISTA XANTHOTIS (Milne-Edwards)

*Pteromys xanthotis* MILNE-EDWARDS, Ann. Sci. Nat., Zool., vol. 8, 1867, p. 301 (Tibet).

*Specimen*.—One from Taochow, Kansu.

This fine flying squirrel is apparently distinct from *melanopterus*, as discussed in the original description of *P. sulcatus*. It may be mentioned that by "Tibet," Milne-Edwards usually signified a part of the country that is now within the borders of China.

<sup>2</sup> Mem. Hist. Nat. Emp. Chinois, vol. 4, pl. 10.

**PETAURISTA YUNNANENSIS (Anderson)**

*Pteromys yunnanensis* ANDERSON, Ann. Mag. Nat. Hist., ser. 4, vol. 16, 1875, p. 282 (Zeugyechen, Yunnan, China).

*Specimens*.—Two from Tsehchung, Yunnan.

In one specimen of this magnificent flying squirrel the white of the underparts is sharply differentiated from the rufous of the under border of the parachute. In the other the transition is gradual and there is a tinge of rufous over most of the underparts.

**Genus SCIUROPTERUS F. Cuvier****SCIUROPTERUS BUECHNERI Satunin**

*Sciuropterus buechneri* SATUNIN, Ann. Mus. Zool. Acad. Imp. Sci. St. Petersb., vol. 7, 1902, p. 549 (Tschortentanm, Kansu, China).

*Specimens*.—Nine from Wutsaishan, Shansi.

Mr. Sowerby found these beautiful little flying squirrels to be an inhabitant of the dense forests that cover the mountains near Wutsai above an altitude of about 7,000 feet. All were brought in by natives, who said that they feed on nuts and pine seeds, as one would expect.

**Family MUSCARDINIDAE****Genus TYPHLOMYS Milne-Edwards****TYPHLOMYS CINEREUS Milne-Edwards**

*Typhlomys cinereus* MILNE-EDWARDS, Bull. Soc. Philom., vol. 11, 1877, p. 9 (western Fukien, China).

*Specimens*.—Four from Kuatun, Fukien.

These are practically topotypes of this rare rodent.

**Family CRICETIDAE****Genus CRICETULUS Milne-Edwards****CRICETULUS ANDERSONI Thomas**

*Cricetulus andersoni* THOMAS, Proc. Zool. Soc. London, 1908, p. 642 (100 miles northwest of Taiyuanfu, Shansi, China).

*Specimens*.—Twenty-five: Chingningchow, Kansu, 1; Yenifu, Shensi, 1; and the following from Shansi: 90 miles west, 8; 50 miles northwest, 5; 20 miles east, 2; and 5 miles south of Taiyuanfu, 8.

Those from northwest of Taiyuanfu are appreciably paler than the ones from west of this locality.

Sowerby found this little hamster distributed all over northern Shansi and Shensi. It was to be met with in any mountainous or hilly country and seemed to be extremely common. They were nearly always caught close to cultivated fields. It would seem that they

make use of any burrow that they encounter, but they do make holes for themselves and these generally go straight into the ground and are round and smooth. At the mouths of the latter one seldom catches any other rodent.

**CRICETULUS GRISEUS GRISEUS (Milne-Edwards)**

*Cricetus (Cricetulus) griscus* MILNE-EDWARDS, Rech. Mamm., 1871, p. 133 (Peking, Chihli, China).

*Specimens.*—Ten: Tientsin, 7, and Tabul, Chihli, 2; and Weihsien, Shantung, 1.

The Tientsin specimens are all in winter pelage and are considerably grayer and less ochraceous than the two summer examples from Tabul.

**CRICETULUS GRISEUS FUMATUS Thomas**

*Cricetulus griseus fumatus* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 4, 1909, p. 503 (Chuchiatai, near Changchun, Kirin, Manchuria).

*Specimens.*—Three from 120 miles northeast of Sansing, Manchuria.

This is a dark race and very distinct.

**CRICETULUS GRISEUS OBSCURUS (Milne-Edwards)**

*Cricetus (Cricetulus) obseurus* MILNE-EDWARDS, Rech. Mamm., 1871, p. 136 (Saratsi, Shansi, China).

*Specimens.*—Eight from 20 miles west of Ningwufu, Shansi.

These specimens are not actually paler than comparable winter material of *griseus typicus*, but they are much more ochraceous.

**CRICETULUS TRITON TRITON (de Winton)**

*Cricetus (Cricetulus) triton* DE WINTON, Proc. Zool. Soc. London, 1899, p. 575 (Northern Shantung, China).

*Specimens.*—Fourteen: Near Tientsin, Chihli, 8; and Weihsien, Shantung, 6.

These are evidently not quite typical. Most of them have all white feet but in several there is more than a suggestion of duskiness about the ankle, thus approaching *fuscipes*.

**CRICETULUS TRITON COLLINUS G. M. Allen**

*Cricetulus triton collinus* G. M. ALLEN, Amer. Mus. Nov., no. 179, 1925, p. 5 (Taipeishan, Tsinglingshan, Shensi, China).

*Specimen.*—One from the Taipeishan district, 80 miles west-southwest of Sianfu, Shansi.

This single immature, a virtual topotype of *collinus*, is appreciably darker than any of the north Shansi specimens at hand.

**CRICETULUS TRITON INCANUS** Thomas

*Cricetulus triton incanus* THOMAS, Abst. Proc. Zool. Soc. London, 1908, p. 45 (12 miles northwest of Kolanchow, Shansi, China).

*Specimens*.—Yenanfu, Shensi, 1; 5 miles south, 11; 20 miles east, 3; and 50 miles northwest of Taiyuanfu, Shansi, 1.

Two of these individuals were compared by G. S. Miller, jr. at the British Museum with the type of *incanus* and pronounced typical. They are very little if any paler, however, than the Tientsin skins that have been referred to *triton typicus*.

Sowerby found them rather uncommon, inhabiting either fields or mountainous country. The burrow is usually very round and descends either perpendicularly or at a very sharp angle for some distance. When the farmers were plowing preparatory to planting winter wheat near Taiyuanfu they often turned up live specimens. When brought to bay in the open they would roll over on their backs and defend themselves from this position. They are very destructive to native crops as they lay up large stores of such grains as beans and millet.

**CRICETULUS TRITON NESTOR** Thomas

*Cricetulus nestor* THOMAS, Proc. Zool. Soc. London, 1907, p. 466 (Kimhoa, 65 miles northeast of Seoul, Korea).

*Specimens*.—Twelve: Near Imienpo, 1, and 60 miles southwest of Kirin, Manchuria, 3; 150 miles up the Yalu River, Korea, 7; and 75 miles northeast of Peking, Chihli, 1.

On the basis of its dark coloration I am compelled to list under this race the above juvenile from Chihli. Two of the specimens are considerably larger than the measurements given Mr. Thomas.

**Genus CRICETISCUS** Thomas**CRICETISCUS CAMPBELLI** (Thomas)

*Cricetulus campbelli* THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 15, 1905, p. 322 (northern Chihli, China).

*Specimens*.—Two from Tabul, Chihli.

In the original description the type locality of this species was erroneously stated to be at a spot about 200 miles north of Chihli, a mistake later corrected by the describer.

**Genus PHODOPUS** Miller**PHODOPUS BEDFORDIAE** (Thomas)

*Cricetulus bedfordiae* THOMAS, Abst. Proc. Zool. Soc. London, 1908, p. 45 (Yulinfu, Shensi, China).

*Specimens*.—Twenty-two: Wutsai, Shansi, 1; Yulinfu, Shensi, 21.

Genus **CLETHRIONOMYS** *Tilesius***CLETHRIONOMYS RUFOCANUS REGULUS** (Thomas)

*Crascomys regulus* THOMAS, Proc. Zool. Soc. London, 1906, p. 863 (Mingyong, Seoul, Korea).

*Specimens*.—Fifty-four: Sungari River, 23, and Imienpo, Manchuria, 23; 150 miles up the Yalu River, 6, and Potaidon, Korea, 2.

There is more individual than geographic variation in the skulls of these specimens. Those from the Yalu River are paler than the Imienpo examples, but this difference may be seasonal.

**CLETHRIONOMYS RUFOCANUS SHANSEIUS** (Thomas)

*Crascomys shanscius* THOMAS, Proc. Zool. Soc. London, 1908, p. 643 (100 miles northwest of Taiyuanfu, Shansi, China).

*Specimens*.—Thirteen from Shansi: 50 miles northwest of Taiyuanfu, 5, and 90 miles west of the same place, 6; 30 miles west of Kueihuacheng, 2.

Sowerby found these red-backed mice most commonly in the vicinity of mossy banks in forests.

Genus **MICROTUS** Schrank**MICROTUS (CARYOMYS) INEZ INEZ** Thomas

*Microtus (Eothenomys) inez* THOMAS, Abst. Proc. Zool. Soc. London, 1908, p. 45 (Kolanchow, Shansi, China).

*Specimen*.—One from Yenanchow, Shensi.

**MICROTUS (CARYOMYS) INEZ NUX** Thomas

*Microtus (Eothenomys) nux* THOMAS, Abst. Proc. Zool. Soc. London, 1910, p. 26 (Shangchow, Shensi, China).

*Specimens*.—Three from Shangchow, Shensi.

This is a darker, less brown animal than *inez typicus* and the relationship of the two is undoubtedly subspecific. Hinton (1926) in his monograph of the voles placed both *inez* and *nux* in the synonymy of *Evotomys rufocanus shanseius* and stated that both of these forms as well as other *Caryomys* were based upon immature specimens of the local subspecies of *Evotomys rufocanus*. The three examples listed above were a part of the original series upon which Thomas based his description of *nux*, and they are conclusively different from the *Evotomys*, or as now termed, *Clethrionomys*, of this locality, of any age whatsoever, both the skins and the skulls departing from the latter in a number of important respects.

**MICROTUS (EOTHENOMYS) MELANOGASTER MELANOGASTER** (Milne-Edwards)

*Arvicola melanogaster* MILNE-EDWARDS, Nouv. Arch. Mus., vol. 7, 1871, p. 93 (Muping, Szechwan, China).

*Specimen*.—One from just south of Mount Omei, Szechwan.

The skull of this single specimen is closer to the typical race than to *mucronatus*.

**MICROTUS (EOTHENOMYS) MELANOGASTER COLURNUS Thomas**

*Microtus (Eothenomys) melanogaster colurnus* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 209 (Kuatun, Fukien, China).

*Specimens*.—Seven from the type locality.

One of these topotypes has four inner salient angles to  $m^3$ , but is otherwise indistinguishable from the rest.

**MICROTUS (ANTELIOMYS) CHINENSIS Thomas**

*Microtus chinensis* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 8, 1891, p. 117 (Kiatingfu, Szechwan, China).

*Specimens*.—Five from Washan, Szechwan.

A late October specimen has a striking golden overtone to the dorsum, caused by minute golden tips to the longer hairs. The remainder were taken during July and are in ragged pelage, somewhat darker.

**MICROTUS (PHAIOMYS) MANDARINUS MANDARINUS (Milne-Edwards)**

*Arvicola mandarinus* MILNE-EDWARDS, Rech. Mamm., 1871, p. 129 (probably near Saratsi, Shansi, China (see G. M. Allen, 1924)).

*Specimens*.—Three, from 5 miles south and 50 miles northwest of Taiyuanfu, Shansi.

Sowerby found these voles inhabiting grassy hillsides.

**MICROTUS (PHAIOMYS) MANDARINUS JOHANNES Thomas**

*Microtus johannes* THOMAS, Abst. Proc. Zool. Soc. London, 1910, p. 25 (12 miles northwest of Kolanchow, Shansi).

*Specimens*.—Five from Wutsai, 20 miles west of Ningwufu, Shansi.

These specimens were compared by Mr. Miller with the type in the British Museum. Sowerby found this race to be an inhabitant of open fields. In his notes he mentioned that the range of mountains lying between Ningwufu and Taiyuanfu evidently constitute a barrier which separates the ranges of true *mandarinus* from the paler race of the Ordos type of desert country to the northwest, just as this range marks the southern boundary in this region of the distribution of *Phodopus* and *Dipus*.

**MICROTUS (PHAIOMYS) PULLUS Miller**

*Microtus pullus* MILLER, Proc. Biol. Soc. Wash., vol. 24, 1911, p. 53 (Chiaochengshan, 90 miles west of Taiyuanfu, Shensi, China).

*Specimens*.—Three (including the type) from the type locality.

It is probable that this animal is but a darker subspecies of *mandarinus*, but the material available is not adequate to establish this

point. Sowerby found it to inhabit the open, grassy hillsides clear to their tops, at 9,500 feet.

**MICROTUS (PILAIOMYS) BRANDTI** (Radde)

*Arvicola brandti* RADDE, Mém. Biol. Acad. St. Petersb., vol. 3, 1861, p. 683 (Mongolia).

*Specimens*.—Six (including the type of *M. warringtoni*) from Tabul, Chihli.

With access to a series of virtual topotypes of *brandti*, G. M. Allen (1924) found that the size of the latter is fully as great as of the specimens upon which G. S. Miller based his description of *M. warringtoni*. As size was the only racial character ascribed to the latter, I follow Allen's example and list all these specimens under the name *brandti*.

**MICROTUS (NEODON) IRENE** Thomas

*Microtus irene* THOMAS, Abst. Proc. Zool. Soc. London, 1911, p. 5 (Tatsienlu, Szechwan, China).

*Specimens*.—Two from Szechwan; Shuowlow, 1, and 10 miles south of Tatsienlu, 1.

Although these specimens differ from one another in several respects, they are both assigned to this species for the present.

**MICROTUS (STENOCRANIUS) ANGUSTUS** Thomas

*Microtus angustus* THOMAS, Proc. Zool. Soc. London, 1908, p. 108 (about 100 miles northwest of Kalgan, Chihli, China).

*Specimens*.—Four from Tabul, Chihli.

These are virtual topotypes.

**MICROTUS CALAMORUM CALAMORUM** Thomas

*Microtus calamorum* THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 10, 1902, p. 167 (near Nanking, Kiangsu, China).

*Specimens*.—Twenty from Yochow, Hunan.

There is some resemblance of this large vole to *M. pelliceus*, as already pointed out by Thomas, but the relationship is hardly nearer than specific. Hoy found many nestling young in early June, and it is gathered from his field catalog that this species inhabits fairly dry fields as well as the rushy growths of swampy areas.

**MICROTUS CALAMORUM SUPERUS** Thomas

*Microtus calamorum superus* THOMAS, Abst. Proc. Zool. Soc. London, 1911, p. 27 (30 miles south of Fenghsiangfu, Shensi, China).

*Specimen*.—One skull only from Taipingsha, Shensi.

**MICROTUS PELLICEUS** Thomas

*Microtus pelliceus* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 383 (Ussuri River, Siberia).

*Specimens.*—Twenty-nine from the Sungari River, 60 miles southwest of Kirin, Manchuria.

In this species the incisors are much longer and project farther than in *M. calamorum*.

## Family RHIZOMYIDAE

## Genus RHIZOMYS Gray

## RHIZOMYS DAVIDI Thomas

*Rhizomys davidi* THOMAS. Abst. Proc. Zool. Soc. London, No. 90, 1911, p. 5 (Kuatun, Fukien, China).

*Specimens.*—Three from Yenpingfu, Fukien.

The skulls of the two largest individuals show some differences and it is by no means impossible that the largest and smallest specimens may ultimately prove to be *sinensis*, but in the absence of undoubted representatives of the latter race, and in view of the fact that they are all from the same place, it is certainly wiser to refer these specimens to *davidi*.

## RHIZOMYS VESTITUS Milne-Edwards

*Rhizomys vestitus* MILNE-EDWARDS, Nouv. Arch. Mus., 1871, p. 93 (Muping, Szechwan, China).

*Specimens.*—Five from Szechwan: Wenchwan, 3, and Wanhsien, 2.

The condylobasilar measurement of some of these skulls is larger (74 mm.) than that given by the describer for *vestitus*, but the resemblance seems to be with this form rather than *R. wardi*.

## Family SPALACIDAE

## Genus MYOSPALAX Laxmann

The four forms of this genus at hand are certainly not all distinct species, but the binomial should be used for them until a better understanding of the Asiatic moles has been gained.

## MYOSPALAX CANSUS (Lyon)

*Myotalpa cansus* LYON, Smiths. Misc. Coll., vol. 50, 1907, p. 134 (Taochow, Kansu, China).

*Specimens.*—Twenty-one: Yeninfu, 1 and Yulinfu, Shensi, 5; and the following from Kansu; 15 miles southeast of Choni, 1; 15 miles northeast of Chengning, 8; Taochow, 1 (the type); 30 miles south of Lanchow, 4; and near Archuen, Minshan Mountains, 1.



The type of *M. cansus* is male and not female as at first recorded. On the basis of the present material I can not recognize the subspecies *shenseius* even though topotypes are at hand. The difference in coloration is not sufficient to constitute a tenable character and the length of the maxillary tooth row does not prove to be longer in the Shensi skulls. The color of the four specimens from south of Lanchow is puzzling in that it is practically entirely gray, and the skull of at least one shows some variation; but they are all rather immature and no other disposition can be made of them at present.

**MYOSPALAX FONTANUS Thomas**

*Myospalax fontanus* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 9, 1912, p. 93 (Ningwufu, Shansi, China).

*Specimens*.—Thirteen from Shansi as follows: 20 miles west of Ningwufu, 9; 10 miles south of Wutsai, 1; and 90 miles west of Taiyuanfu, 3.

The three specimens from west of Taiyuanfu are not appreciably different from the virtual topotypes of this large, rather pale form. As is *M. fontanieri* the second nail of the manus is as long as the third. All Sowerby ever saw were dug up by natives while working in their fields, or had been flooded out by irrigation. They are remarkable diggers and he once watched one work its way with astonishing rapidity into the packed ground of a Chinese courtyard. They are clumsy but can get up a fair speed. They dislike light intensely and always try to hide away in some dark corner. When feeding they hold the food down with their forefeet.

**MYOSPALAX ROTHSCHILDI Thomas**

*Myospalax rothschildi* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 8, 1911, p. 122 (40 miles southeast of Taochow, Kansu, China).

*Specimens*.—Five skulls and four skins from Taochow, Kansu.

Although all of these specimens are immature I have no hesitation in assigning them to this distinct species, for not only has the pelage a soft quality and distinctive silvery sheen, but the skull characters of shortness of molar rows and two inner reentrant angles of  $m^3$  are shown to good advantage. Additional items of interest are the shortness and hairiness of the tail, relative width of the anterior nasals, slight development of the infraorbital septum of the maxilla, medial palatal spine, form of the hamular processes, and paleness of the incisors.

**MYOSPALAX SMITHII Thomas**

*Myospalax smithii* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 8, 1911, p. 720 (30 miles southeast of Taochow, Kansu, China).

*Specimens*.—Two from Kansu: 30 miles east-southeast of Lanchow, 1; and "probably Choni," 1.

Although not adult the last-mentioned specimen is indubitably assignable to this species on the characters of temporal fossae, interorbital, and third upper molar. An additional detail of importance is the basioccipital, which extends farther ventrad than any part of the bullae. Unfortunately the second specimen is still younger. Although belonging to this group it is considerably different, for the pelage is of a delicate maltese gray with no trace of buffy or brown, the infraorbital foramina are very small, the basioccipital higher in respect to the bullae, and the inner reentrant angles of the molars are deeper.

The occurrence of so many forms of this genus in the neighborhood of Taichow is very remarkable, but they have trustworthy characters and there is no reason for doubting their validity.

## Family MURIDAE

### Genus MERIONES Illiger

#### MERIONES PSAMMOPHILUS (Milne-Edwards)

*Gerbillus psammophilus* MILNE-EDWARDS, Rech. Mamm., 1871, p. 144 (Mongolia).

*Specimens*.—Twenty-one: Yulinfu, 2, and Yeninfu, Shensi, 6; 5 miles south, 6, and 20 miles northwest of Taiyuanfu, 2, and 20 miles west of Ningwufu, Shansi, 5.

The Shensi examples average paler and more ochraceous than those from Shansi and it is a question whether the two lots should not be separated. The claws are white, hairs of the underparts almost lacking ochraceous bases, and bullae at times touching the zygomatic arches; but the bullae are so little larger than those of *unguiculatus* that this is a poor character for differentiation. While Mr. Sowerby was in the Ordos Desert he frequently had opportunity for watching these lively creatures playing about the mouths of their burrows in broad daylight, while elsewhere he has never seen them during the day. They are largely colonial.

#### MERIONES UNGUICULATUS (Milne-Edwards)

*Gerbillus unguiculatus* MILNE-EDWARDS, Ann. Sci. Nat., vol. 7, 1867, p. 377 (Mongolia).

*Specimens*.—Two from Tabul, Chihli.

The claws of this species are black, belly hairs plumbeous at base and with the suggestion of a buffy overwash, and the bullae never touch the zygomatic arches.

## Genus RHOMBOMYS Wagner

## RHOMBOMYS OPIMUS NIGRESCENS (Satunin)

*Gerbillus opimus nigrescens* SATUNIN, Ann. Mus. Zool. Acad. Imp. Sci. St. Petersb., vol. 7, 1903, p. 560 (Oroknor, central Mongolia).

*Specimens*.—Nine from 45 to 105 miles northwest of Ninghsia, Kansu.

The validity of this race has not definitely been established and I have not the material to settle the question, but these specimens fit the description admirably.

## Genus APODEMUS Kaup

## APODEMUS AGRARIUS COREAE Thomas

*Apodemus agrarius coreae* THOMAS, Proc. Zool. Soc. London, 1908, p. 8 (Ming-yong, 110 miles southeast of Seoul, Korea).

*Specimens*.—Five from 65 to 75 miles northeast of Peking, Chihli.

These are not greatly different from *A. g. mantchuricus* but average duller, with black stripe narrower.

## APODEMUS AGRARIUS MANTCHURICUS (Thomas)

*Mus agrarius mantchuricus* THOMAS, Proc. Zool. Soc. London, 1898, p. 774 (Manchuria).

*Specimens*.—Forty-four from Manchuria: 60 miles southwest of Kirin, 21; 120 miles northeast of Sansing, 6; 180 miles up the Yalu River, 2; Fengtien, 2; and Imienpo, 13.

It is by no means certain that the Yalu River examples should not be called *coreae*.

## APODEMUS AGRARIUS NINGPOENSIS (Swinhoe)

*Mus ningpoensis* SWINHOE, Proc. Zool. Soc. London, 1870, p. 637 (Ningpo, Chekiang, China).

*Specimens*.—Forty-eight: Yochow, Hunan, 37; Taiping, Anhwei, 4; Nanking, 5; Chinkiang, 1; and Shanghai, Kiangsu, 1.

In typical immatures there is quite a strong black dorsal stripe, but not to the extent occurring in true *agrarius*. In the Anhwei adults, however, there is but the faintest indication of this stripe, while in the Hunan examples it is a bit better defined, though still faint in all but two. Coloration is both pale and dull, with pelage short and having less of the grayish ticking exhibited by *pallidior*.

## APODEMUS AGRARIUS PALLIDIOR (Thomas)

*Apodemus agrarius pallidior* THOMAS, Proc. Zool. Soc. London, 1908, p. 7 (Chefoo, Shantung, China).

*Specimens*.—Eight: Near Tientsin, Chihli, 2; 15 miles south of Sianfu, 3, and Yen-anfu, Shensi, 3.

This is a paler, sandier race with fine black stripe. The two specimens from Tientsin are excessively pale and gray, and were taken during January.

**APODEMUS SPECIOSUS PENINSULAE (Thomas)**

*Micromys speciosus peninsulae* THOMAS, Proc. Zool. Soc. London, 1906, p. 862 (Mingyong, 110 miles southeast of Seoul, Korea).

*Specimens.*—Eighty-seven: Fengtien, 2, Imienpo, 20, and 60 miles southwest of Kirin, Manchuria, 11; 150 miles up the Yalu River, 3, and Potaidon, Korea, 2; 65 to 75 miles northeast of Peking, Chihli, 12; 18 to 90 miles west of Taiyuanfu, 9, 20 miles east of Taiyuanfu, 11, and 30 miles west of Kueihuacheng, Shansi, 5; Taipeishan district, 2, 12 miles south of Yen-anfu, 4, 15 miles west of Sianfu, 4, and 80 miles west southwest of Sianfu, Shensi, 2; and 15 miles south of Lanchow, Kansu, 1.

Included in the above list is the material upon which *A. praetor* was based. The type of this is a phenomenally large specimen such as is encountered occasionally in almost all groups of rodents. No other individual of this *praetor* series is as large as the measurements given by Thomas for *peninsulae*. The darker, less yellowish coloration ascribed to *praetor* is seasonal and is a character of the short, summer coat, which, however, may be retained until October. No winter or spring specimen has this type of coloration but at these seasons they are more ruddy. The Chihli series, also in the short, dull, summer coat, have tails that are usually shorter than the head and body. In Shansi and Shensi Sowerby found these mice in almost all wooded or brushy country.

**APODEMUS DRACO (Barrett-Hamilton)**

*Mus sylvaticus draco* BARRETT-HAMILTON, Proc. Zool. Soc. London, 1900, p. 418 (Kuatun, Fukien, China).

*Specimens.*—Four from Kuatun, Fukien.

From his papers I judge that Thomas is somewhat doubtful regarding the exact status of *draco*. I share his uncertainty in this respect and the identification must be provisional. These should certainly be topotypes of *draco*, but Barrett-Hamilton stated that this is a subspecies of *sylvaticus* and brighter above than *typicus*, while the specimens at hand are definitely darker. They are not subspecies of *sylvaticus*, for there are eight mammae and they have the short incisive foramina of *speciosus*—not the long ones of *sylvaticus*. Thomas mentioned that *draco* has eight mammae but stated nothing further anent its systematic position.

## Genus RATTUS G. Fischer

## RATTUS RATTUS RATTUS (Linnaeus)

[*Mus*] *rattus* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 61 (Upsala, Sweden).

*Specimen*.—One from Futsing, Fukien.

The only specimen of all black rat secured was this juvenile, too young for other characters to be distinguishable. It probably belongs to this race, to be expected anywhere near the coast, although it is not impossible that it may be a melanistic individual of some other form.

## RATTUS RATTUS ALEXANDRINUS (Geoffroy)

*Mus alexandrinus* GEOFFROY, Cat. Mamm. Mus. Hist. Nat. Paris, 1803, p. 192 (Alexandria, Egypt).

*Specimen*.—One, from 150 miles up the Min River, Fukien.

This example is indistinguishable from selected European skins and this, together with the fact that it was taken by a river whence it could have been transported by boat, obliges me to identify it as of this race. The tail is 142 per cent of the head and body length and the total length of the skull is 40.5 mm. The length of the tail renders it unlikely that it might properly be ascribed to *sladeni*.

## RATTUS RATTUS EXIGUUS A. B. Howell

*Rattus rattus exiguus* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 40, 1927, p. 43 (70 miles southwest of Yenpingfu, Fukien, China).

*Specimens*.—Sixteen, from the following localities in Fukien: 14 from 70 miles southwest of Yenpingfu, at an altitude of 500 feet; one from Foochow; and one in spirits from Kulingsu Island.

This race is readily distinguished from *sladeni* and *alexandrinus* by its pale color, small size and short foot, and from the latter at least by the shorter tail. It should be distinguished without trouble from any other rat of eastern China, although I suspect that it has at times been mistaken for *humiliatus*, which is evidently very rare in collections.

## RATTUS HUMILIATUS HUMILIATUS (Milne-Edwards)

*Mus humiliatus* MILNE-EDWARDS, Rech. Mamm., 1871, p. 137 (Peking, Chihli, China).

*Specimens*.—Three: Chinkiang, Kiangsu, 1; and Canton, Kwangtung, 2.

The Kiangsu example is the only one of the above with measurements and its tail is 93 per cent of the head and body length. Very conflicting measurements have been given for this species, but those who have examined the type are evidently in accord that the tail is shorter than the head and body. In manuscript notes on type speci-

mens in the Paris Museum, G. S. Miller, jr., has said that there are two mounted cotypes of this rat and that the measurements are: head and body, 160 and 150; tail 100 and 96; and foot, 30 and 33 mm. It is very probable that other Chinese rats have often been misidentified as this, which seems to be exceedingly rare in collections. From *R. r. alexandrinus* its skull is distinguishable only by the fact that in the latter the anterior portion of the nasals are usually abruptly wider, the temporal ridging heavier, and incisive foramina broader; but these details are not always uniform. The best criterion for differentiating the two is the great difference in the length of the tail. Some might therefore conclude that *humiliatus* should stand as a subspecies *R. rattus*. And it really seems no more distant from *alexandrinus* than it does from *R. r. coiguus*. I am inclined to believe, however, that although related most nearly to the *rattus* group, *humiliatus* is specifically distinct and probably would not cross, under normal conditions, with either of the two rats mentioned. Immature skins of *humiliatus* may be difficult to distinguish from similar specimens of *R. norvegicus*, but in adults the silky pelage of the former is diagnostic.

**RATTUS HUMILIATUS INSOLATUS A. B. Howell**

*Rattus humiliatus insolatus* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 40, 1927, p. 44 (near Yen-anfu, Shensi, China).

*Specimens*.—Four from Shensi: Yen-anfu, 3 (including the type); and Yulinfu, 1.

This is a rather large and pale race.

**RATTUS HUMILIATUS SOWERBYI A. B. Howell**

*Rattus humiliatus sowerbyi* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 42 (near Imienpo, north Kirin, Manchuria).

*Specimens*.—Two, including the type, from the type locality.

This also is a large race, but dark and richly colored and with the sootiness of the face pronounced. Superficially it is not unlike *R. norvegicus* but the softness of the pelage is distinctive, at least in adults.

**RATTUS FLAVIPECTUS (Milne-Edwards)**

*Mus flavipectus* MILNE-EDWARDS, Nouv. Arch. Mus. Hist. Nat., 7, 1871, p. 93 (Muping, Szechwan, China).

*Specimens*.—Forty-three: Foochow, 3; Kuliang, 2; Futsing, 4; near Yenpingfu, 4; and 70 miles southwest of Yenpingfu, Fukien, 1; near Chinkiang, 7, and Shanghai, Kiangsu, 21; Canton, Kwangtung, 1; and Mount Omei, Szechwan, 1.

The dorsal coloration of this series is rather uniform, but several of the older individuals have a very few white hairs scattered over

the back. Below there is more variation. The majority have a strongly ochraceous overwash but in many the underparts are grayer, this evidently being due to the wearing away of the hair tips. There is invariably some ochraceous about the chest, however. In but three is there a white pectoral area. The brown of the fore feet is not always sufficiently pronounced to be distinguishable if the specimen is at all dirty or greasy. In the Kiangsu skulls the infra-orbital laminae of the maxillae average shorter, but their separation on this character alone is hardly justifiable at present.

**RATTUS GRISEIPECTUS (Milne-Edwards)**

*Mus griseipectus* MILNE-EDWARDS, Nouv. Arch. Mus. Hist. Nat., vol. 7, 1871, p. 93 (Szechwan, China).

*Specimens*.—Four: 70 miles southwest of Yenpingfu, Fukien, 1; and Yochow, Hunan, 3.

The adult from Fukien measures as follows: head and body, 167; tail, 183; and hind foot, 36. The total length of the skull is 44 mm. Two of the Hunan specimens are alcoholics. The third is much brighter than the one from Fukien and correspondingly more nearly resembles *humiliatus* in appearance, but the size of the skull with large rostrum and long tail is always sufficient to separate the two species. The identification of the two alcoholics is tentative.

**RATTUS NORVEGICUS CARACO (Pallas)**

*Mus caraco* PALLAS, Nov. Spec. Quad. Glir. Ord., 1878, p. 91 (eastern Siberia).

*Specimens*.—Seventeen from Manchuria: Imienpo, 2, 60 miles southwest of Kirin, 6, and 120 miles northeast of Sansing, 9.

This rat is differentiated from *typicus* chiefly by its dark color, less decidedly brown.

**RATTUS NORVEGICUS SOCCER (Miller)**

*Epimys norvegicus soccer* MILLER, Proc. Biol. Soc. Wash., vol. 27, 1914, p. 90 (Taochow, Kansu, China).

*Specimens*.—Sixty-eight: Tientsin, 2; Peking, 20; 80 miles east of Peking, 16, 65 to 75 miles northeast of Peking, 7; and Chingwangtao, Chihli, 1; Taochow, 5 (including the type); Lanchow, 2; and Archuen in the Minshan Mountains, Kansu, 2; Suifu, Szechwan, 10; Canton, Kwangtung, 2; and Amoy Island, Fukien, 1.

The majority of these specimens are distinguishable from an average of north European examples of the brown rat but along the coast and larger rivers of China there is bound to have been an infusion of rats brought in by shipping and the correct identification of all specimens in the case of two such slightly differentiated races is manifestly impossible. The Suifu skins are definitely browner of belly and darker of back, but they were made up from salted pelts and one cannot place reliance in these characters.

**RATTUS CONFUCIANUS CONFUCIANUS (Milne-Edwards)**

*Mus confucianus* MILNE-EDWARDS, Nouv. Arch. Mus. Hist. Nat., vol. 7, 1871, p. 93 (Muping, Szechwan, China).

*Specimens*.—Fifty-two: Tatsienlu, 4; Suifu, 6; and Wenchwan, Szechwan, 5; Nanking, 1; and Chinkiang, Kiangsu, 8; Yenpingfu, 19; 70 miles southwest of Yenpingfu, 2; Kuliang, 1; Peiliang, 1; Futsing, 1; and Kuatun, Fukien, 2.

The Szechwan skins were made up from salted pelts and all that can be said of them is that at least most of them are true *confucianus*, for about those with fragmentary skulls little can be told. One of the Suifu examples differs in being excessively spiny over the shoulders but not upon the rump. The skull is broken to bits, however. It was expected that the Fukien rats of this species would prove to be of the race *littoreus* Cabrera, but such is not the case, for the color is quite dark, there is very little dusky upon the feet of any of them, and instead of having a short tail this member is quite long. The specimens at hand are rather small for typical *confucianus* but the measurements for this as given by various investigators are conflicting and I follow G. M. Allen in thus identifying the material from this part of China.

Most of the skins were taken in April and the pelage of these is relatively nonhispid, but those secured in late summer are quite spiny. The feet of the majority are pure white and in very few does the dusky area extend beyond the ankle. The tip of the tail usually shows at least some indication of white above, and in a few the terminal third is entirely white.

Skulls may be distinguished from those of *huang* by the fact that the temporal ridges hardly ever extend to the interparietal, but they are otherwise very similar indeed. It should be mentioned that in all the older females the rostrum is definitely broader than in any male save one, although it is possible that this may be fortuitous. Two have skulls that are considerably larger than the others but otherwise they are similar. The skins from Kiangsu have feet that average larger (29 mm). Average measurements of five large specimens from Fukien are: head and body, 132; tail, 179; hind foot, 27; and total length of skull, 35.5 mm.

**RATTUS CONFUCIANUS CHIHLIENSIS Thomas**

*Rattus confucianus chihliensis* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 20, 1917, p. 199 (65 miles east of Peking, Chihli, China).

*Specimens*.—Fifteen from Chihli: Chingwangtao, 4; and 65 to 75 miles northeast of Peking, 11.

The above north China specimens are virtually topotypes. Three of the Chingwangtao skulls are missing but the skins are assigned



to this race on the basis of their dusky metapodials. Another character differentiating *chihliensis* from Fukien *confucianus* is the slenderness of the rostrum; and the bullae average a shade smaller.

**RATTUS CONFUCIANUS LUTICOLOR (Thomas)**

*Mus confucianus luticolor* THOMAS, Abst. Proc. Zool. Soc. London, 1908, p. 45 (Yenanfu, Shensi, China).

*Specimens*.—Eighteen: Yenanfu, 7; 15 miles south of Sianfu, Shensi, 3; 50 miles northwest of Taiyuanfu, 2; 20 miles east of Taiyuanfu, 5; and 30 miles west of Kweiuating, Shansi, 1.

Two of the specimens from Sianfu are darker and the third much more ruddy than topotypes, and the two former at least probably vary toward the race *canorus*. Those from east of Taiyuanfu might almost as well be placed with *chihliensis*. Sowerby found these rats most commonly among the rocks along the sides of the valleys.

**RATTUS CONFUCIANUS SACER (Thomas)**

*Mus confucianus sacer* THOMAS, Proc. Zool. Soc. London, 1908, p. 6 (Chefoo, Shantung, China).

*Specimens*.—Twenty-two from Hunan; Changsha, 2; Yochow, 20.

I have had no opportunity to examine topotypes of this race, but as I understand *sacer* it is an illy defined subspecies representing various degrees of intergradation between *confucianus* and *chiliensis*, and farther west, *luticolor* also. These Yochow skins are considerably brighter than true *confucianus* but darker than *luticolor*, and are variously intermediate in other ways. It may be noted that Yochow is not in Honan, as mentioned by Allen (1926) but in Hunan, which puts a somewhat different interpretation upon specimens from that locality.

**RATTUS HUANG HUANG (Bonhote)**

*Mus huang* BONHOTE, Abst. Proc. Zool. Soc. London, 1905, p. 387 (Kuatun, Fukien, China).

*Specimens*.—Thirty-nine from Fukien: 70 to 75 miles southwest of Yenpingfu, 31; Yenpingfu, 2; Peiliang, 1; Foochow, 1; and Kuatun, 4.

This fine series seems to be perfectly typical, although only the very largest specimens equal the measurements usually given for this species. On the other hand, the smallest adult is considerably larger than the dimensions given for *ling*. In the series at hand there is comparatively little color variation save what is ascribable purely to wear, but there is much as regards spininess of pelage. The fresh, unworn coat has very few and slender spines but the latter increase in number and size as wear of the hairs progresses, until in very ragged individuals the middle back and rump are covered thickly with them.

There is little cranial variation also, save to some extent in the shape of the posterior termination of the nasals. Skulls may be told from those of *confucianus* chiefly by the extension in the former of the temporal ridges as far as the interparietal. The rostrum also averages more slender and the interpterygoid narrower. Average measurements of five large specimens are: Head and body, 135; tail, 190; foot, 28; ear, 19; and length of skull, 35.8 mm.

**RATTUS EDWARDSI EDWARDSI (Thomas)**

*Mus edwardsi* THOMAS, Proc. Zool. Soc. London, 1882, p. 587 (western Fukien, China).

*Specimens*.—Two from Kuantun, Fukien.

These very large rats may be considered topotypical, and their skulls measure 61 and 58 mm. in length.

**RATTUS EDWARDSI GIGAS (Satunin)**

*Mus gigas* SATUNIN, Ann. Mus. Zool. Acad. Imp. Sci. St. Petersb., vol. 7, 1903, p. 562 (Valley of Chodzigou, near Lunganfu, Szechwan, China).

*Specimens*.—Two from southwest of Mount Omei, Szechwan.

These two specimens are not distinguishable with certainty from those of Fukien, but G. M. Allen considers *gigas* to be a valid race and doubtless with adequate material differences would be readily apparent.

**RATTUS LATOUCHEI (Thomas)**

*Mus latouchei* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 20, 1897, p. 13 (Kuantun, Fukien, China).

*Specimens*.—Three: Mount Omei, Szechwan, 1; and 70 miles southwest of Yenpingfu, Fukien, 2.

One of the Fukien examples is but half grown and the dorsal coloration is dark sooty with practically no vestige of brown—a type of juvenal coloration usual in cricetid rats but apparently rare in murids. The head, however, has assumed the adult pelage. The larger specimen measures; head and body, 252; tail, 334; foot, 52; and ear, 35 mm. It shows a head coloration that is typical of the species but the body color is evidently unusually dark, being without white tips to any of the hairs. Most of the skull is broken but there remains sufficient to show the cranial characters of *latouchei*, consisting chiefly of the large size in connection with the fact that the dentations of the premaxillary-frontal sutures do not extend caudad of the posterior tips of the nasals.

Perhaps the Szechwan specimen should be referred to *mackenzii*, of which no examples are at hand, but the measurements (hind foot 57) are larger than are supposed to occur in that race, and both skin and skull are practically indistinguishable from the Fukien adult.

Genus *MUS* Linnaeus*MUS MUSCULUS MUSCULUS* Linnaeus

[*Mus*] *musculus* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 62 (Sweden). \*

*Specimens*.—Twenty-three: Peking, Chihli, 3; Kwantsao, Weichow, 3; Suifu, Szechwan, 9; Nanking, Kiangsu, 4; and 70 miles southwest of Yenpingfu, Fukien, 4.

The Suifu specimens are dirty and misshapen and mostly prepared from salted skins. The Chihli examples are also dirty. The only practicable course has therefore been to refer all dark-bellied *Mus* to *musculus*. Instead of being darker than typical *musculus*, as *sinicus* was said to be, the material from south China averages lighter.

*MUS BACTRIANUS GANSUENSIS* Satunin

*Mus* [*Leggada*] *gansuensis* SATUNIN, Ann. Mus. Zool. Acad. Imp. Sci. St. Petersb., vol. 7, 1903, p. 564 (Tschortentan, Kansu, China).

*Specimens*.—Two from 128 to 157 miles west-northwest of Pao-touchen, Inner Mongolia, and the following from Kansu; near Ninghsia and up to 60 miles west thereof, 7; Lanchow, 1; and 25 miles southeast of Sining.

I shall follow the example of G. M. Allen (1927) in placing the races of white-bellied *Mus* of China under the species *bactrianus* rather than *wagneri* as usual; but there are no undoubtedly typical specimens of the former available. This series is very pale, with short tail (about 45 per cent of the total length), and without a buffy throat patch.

*MUS BACTRIANUS MONGOLIUM* Thomas

*Mus wagneri mongolium* THOMAS, Proc. Zool. Soc. London, 1908, p. 106 (100 miles northwest of Kalgan, Mongolia).

*Specimens*.—Fourteen: 3 from near Taiyuanfu, Shensi, and the following from Chihli: Tabul, 6; 80 miles east of Peking, 3; and Tientsin, 2.

The Tabul specimens are virtual topotypes and were compared by G. S. Miller with the typical series at the British Museum. These fourteen skins average much darker than the material from Kansu, which I am justified in considering to represent *gansuensis*. Hence, I can not agree with G. M. Allen (1927) in placing in synonymy under the latter the name *mongolium*.

*MUS BACTRIANUS MANCHU* Thomas

*Mus wagneri manchou* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 4, 1909, p. 502 (Chuchiatai, near Changchun, Kirin, Manchuria).

*Specimens*.—Seven from Manchuria: 60 miles southwest of Kirin, 5, and 180 miles up the Yalu River, 2.

This race is considerably darker than *mongolium*.

## Genus MICROMYS Dehne

## MICROMYS MINUTUS PYGMAEUS (Milne-Edwards)

*Mus pygmaeus* MILNE-EDWARDS, Rech. Mamm., 1874, p. 291 (Szechwan, China).

*Specimens*.—Five: Yo Chow, Hunan, 3; and Nanking, Kiangsu, 2.

The Hunan examples are very ochraceous—especially one of them—but I have in mind the ochraceous tones assumed by certain American *Dipodomys* living on particular types of alkali soil and prefer to call these specimens as above until more material is available.

## Genus VANDELEURIA Gray

## VANDELEURIA OLERACEA (Bennett)

*Mus oleracea* BENNETT, Proc. Zool. Soc. London, 1832, p. 121 (Dukhun, India).

*Specimen*.—One from Yangchiaoshan, Yunnan.

The single representative of this rare genus in the National Museum was caught alive in a nest of grass situated in a bush.

## Family ZAPODIDAE

## Genus SICISTA Gray

## SICISTA CONCOLOR (Büchner)

*Sminthus concolor* BÜCHNER, Mém. Biol. Acad. St. Petersb., vol. 13, 1892, p. 268 (Mountains of Sining, Kansu, China).

*Specimen*.—One from near Imienpo, Manchuria.

This is an immature and there is nothing to do but refer it to this species.

## Genus ZAPUS Coues

## ZAPUS SETCHUANUS VICINUS Thomas

*Zapus setchuanus vicinus* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 402 (46 miles southeast of Taochow, Kansu, China).

*Specimens*.—Two from Kansu; Choni, 1, and Archuen, Minshan Mountains, 1.

These two specimens are identified upon geographic grounds as there is no comparative material of this genus at hand. The belly is entirely white but the tail of neither is black above to the tip.

## Family DIPODIDAE

## Genus ALLACTAGA F. Cuvier

## ALLACTAGA MONGOLICA ANNULATA (Milne-Edwards)

*Dipus annulatus* MILNE-EDWARDS, Ann. Sci. Nat., vol. 7, 1867, p. 376 (probably near Peking, Chihli, China).

*Specimens*.—Two from Chihli: Tabul, 1, and 100 miles west of Lamamiao, 1.

As no specimens of undoubted *mongolica typicus* are available I follow the opinion of G. M. Allen (1925) in considering that Chihli examples are separable.

#### ALLACTAGA MONGOLICA LONGIOR Miller

*Allactaga mongolica longior* MILLER, Proc. Biol. Soc. Wash., vol. 24, 1911, p. 54 (15 miles northeast of Chingningchow, Kansu, China).

*Specimens*.—Thirteen from Kansu: From the type locality, 12, including the type; and 45 miles northwest of Ninghsia, 1.

Not only are the ear and foot of this race distinctly longer than in Chihli specimens but the toes are heavier and longer. In regard to specimens which he kept in captivity, Sowerby found that they slept upon the side or back and if disturbed would kick and bite savagely. When not on the alert they had a queer habit of drooping the terminal half of the ears. Efforts to trap them proved unsuccessful, probably because no bait could be found to tempt them. The natives secured them by digging them out of their holes, "but," says Sowerby, "it takes a native to find the hole." They are called by the suggestive native name tiao-tu-tze, which means "jumping rump."

#### Genus EUCHOREUTES Sclater

##### EUCHOREUTES NASO ALASHANICUS A. B. Howell

*Euchoreutes naso alashanicus* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 42 (Alashan Desert, Inner Mongolia, 100 miles north-northwest of Ninghsia, Kansu, China).

*Specimen*.—One, the type.

This is an ochraceous and pale race, with larger bullae.

#### Genus DIPUS Zimmermann

##### DIPUS SOWERBYI Thomas

*Dipus sowerbyi* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 2, 1908, p. 307 (Yulinfu, Shensi, China).

*Specimens*.—Nine from Shensi: Yulinfu, 7; and 13 and 15 miles north of Yulinfu, 2.

Sowerby found these jerboas capable of making enormous leaps and one jumped out of a water jar three feet deep. Some which he kept in captivity slept during the day, usually lying on their sides, and so soundly did they sleep that one could pick them up and handle them without arousing them. Several times when in this condition they were thought to be dead. They are very frugal eaters, merely nibbling at vegetables or grain. They hibernate during the cold weather.

## Family HYSTRICIDAE

## Genus ACANTHION F. Cuvier

## ACANTHION SUBCRISTATUS (Swinhoe)

*Hystrix subcristata* SWINHOE. Proc. Zool. Soc. London, 1870, p. 638.

*Specimen*.—One from Suifu, Szechwan.

This specimen, the only Chinese porcupine in the National collection, is a juvenile, with flat skin and broken skull, but on the strength of the relatively long nasals, which extend much farther back than opposite the anterior border of the orbit. I venture to class it with the species of eastern China, rather than with *yunnanensis*.

## Order LAGOMORPHA

## Family OCHOTONIDAE

## Genus OCHOTONA Link

## OCHOTONA (OCHOTONA) DAURICA DAURICA (Pallas)

*Lepus dauuricus* PALLAS. Reise, vol. 3, 1776, p. 692 (Mongolia).

*Specimens*.—Eight from Tabul, Chihli.

This series, in summer pelage, is of very uniform coloration.

## OCHOTONA (OCHOTONA) DAURICA ANNECTENS Miller

*Ochotona annectens* MILLER. Proc. Biol. Soc. Wash., vol. 24, 1911, p. 54 (Chingningchow, Kansu, China).

*Specimens*.—Seven from Kansu: 15 miles northeast of Chingningchow, 6, including the type; 116 miles east of Lanchow, 1.

As compared with available *bedfordi* the skull differences of *annectens* are too slight to be of great value in diagnosis. The body, and especially the hind feet, of the latter are the smaller, however, and the coloration is a faint shade darker. Where the above specimen was secured east of Lanchow, Sowerby found that the animals had their burrows in the (presumably rather bare) sides of the small gullies in loess gulches.

## OCHOTONA (OCHOTONA) DAURICA BEDFORDI Thomas

*Ochotona bedfordi* THOMAS. Abst. Proc. Zool. Soc. London, 1908, p. 45 (Ningwufu, Shansi, China).

*Specimens*.—Seven: Wutsai, 3, and 30 to 50 miles northwest of Taiyuanfu, Shansi, 3; and 12 miles south of Yen-anfu, Shensi, 1.

These are in full winter pelage, being in color very similar to *daurica typicus* but paler. The one from near Yen-anfu is grayer. Sowerby found the burrows usually in very dense scrub where the sharp-thorned wild jujube afforded protection from enemies.

**OCHOTONA (OCHOTONA) HUANGENSIS (Matschie)**

*Conothoa huangensis* MATSCHIE, Wissens. Erg. Exped. Filchner China und Tibet, vol. 10, pt. 1, 1908, p. 214 (between Sianfu and Lanehow, Kansu, China).

*Specimen*.—One from 30 miles west of Sining, Kansu.

From the description of this race one infers that it is a member of the *daurica* group. The above specimen is comparable to this in color, and the bullae are about the same size but larger than in *bedfordi*, as Matschie said. The pelage, however, is of an entirely different quality, being relatively short and very woolly—not coarse as in *daurica* and its allies. The skull, too, is considerably more arched and the interorbital ridging is sharp and pinched in. The claws are entirely black and very long, although the latter feature may, of course, be due to local conditions.

**OCHOTONA (OCHOTONA) ERYTHROTIS VULPINA A. B. Howell**

*Ochotona (Ochotona) erythrotis vulpina* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 117 (30 miles west of Sining, Kansu, China).

*Specimens*.—Three: the type and two topotypes.

Apparently this is the only Chinese subspecies of true *erythrotis*, having a summer coat that is of an intense reddish hue and with hairs entirely lacking black tips. It is of interest that this new race and a specimen of *huangensis* were secured in the same locality.

**OCHOTONA (OCHOTONA) GLOVERI Thomas**

*Ochotona gloveri* THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 9, 1922, p. 190 (Nagchuka, Szechwan, China).

*Specimen*.—One from the type locality.

In addition to the cinnamon ears, this August topotype has the nose of the same color. The relationship of this form to the species *erythrotis* can be considered as no nearer than specific.

**OCHOTONA (OCHOTONA) CHINENSIS Thomas**

*Ochotona (Ochotona) chinensis* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 8, 1911, p. 728 (Yaratsaga, near Tatsienlu, Szechwan, China).

*Specimens*.—Four from Szechwan: Sungpan, 1; Ulongkong (10 miles south of Tatsienlu), 1; and Nganyangba, about 60 miles west of Tatsienlu, 2.

These specimens differ from *gloveri*, which is probably their nearest relative, in being grayer and much darker because of more extensive black tipping of the hairs. The Sungpan individual is paler with more numerous whitish hairs, but can be called nothing else at present.

**OCHOTONA (PIKA) ALPINA ARGENTATA A. B. Howell**

*Ochotona (Pika) alpina argentata* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 116 (15 miles north-northwest of Ninghsia, northern Kansu, China).

*Specimens.*—Two; the type and a tototype.

The array of Chinese pikas that have been described, and especially from Kansu, is quite formidable. Nevertheless it has been necessary to name this race as the Chinese representative of *alpina*. In summer pelage it is of a striking shade of silvery with pale ochraceous rump.

**OCHOTONA (PIKA) SORELLA Thomas**

*Ochotona sorella* THOMAS, Abst. Proc. Zool. Soc. London, 1908, p. 45 (20 miles south of Ningwufu, Shansi, China).

*Specimen.*—One from 50 miles north of Taiyuanfu, Shansi.

This example comes from close to the type locality of *sorella* and it can hardly be doubted that this identification is correct. Its small, slender skull places it in relationship with *O. cansa*, as stated by Thomas, and the dimensions are even smaller (foot 25 mm.) than of the type of *sorella*. Perhaps the fact that this is a midwinter specimen while the type was secured in summer explains the difference in coloration. At any rate the skin at hand is a miniature replica of a specimen of *bedfordi* from the same place, save that the soles of the feet are sooty. Othwise the coloration is identical; but of course the skull is subgenerically different. It is said to be an inhabitant of woods and Sowerby found it to be an extremely rare animal.

**OCHOTONA (PIKA) THIBETANA (Milne-Edwards)**

*Lagomys tibetanus* MILNE-EDWARDS, Nouv. Arch. Mus., vol. 7, 1871, p. 93 (Muping, Szechwan, China).

*Specimens.*—Nine from Szechwan: Sungpan, 4; Washan, 2; and Ulongkong, 10 miles south of Tatsienlu, 3.

The identification of these specimens is largely circumstantial. They are all very poorly made skins of juveniles with fragmentary skulls, but the coloration and palatal foramina of the three in which this part of the skull is intact show at least that they belong to this group. It is interesting to note that both this form and *chinensis* occur at Ulongkong.

**OCHOTONA (PIKA) CANSA MOROSA Thomas**

*Ochotona cansus* LYON, Smiths. Misc. Colls., vol. 50, 1907, p. 136 (Taochow, Kansu, China).

*Specimens.*—Nine, including the type, from Taochow, Kansu.

These are June specimens in which there is considerable variation in tone of pelage because of differences in wear.



## OCHOTONA (PIKA) CANSA MOROSA Thomas

*Ochotona cansa morosa* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 403 (Taipeishan, Shensi, China).

*Specimens*.—Four skulls from the type locality.

The skins to the above skulls can not at present be located but I have no hesitation in their identification for they are very similar indeed to *cansa typicus* and from the type locality of *morosa*. Two of the skulls are larger than the measurements given by Thomas.

## Family LEPORIDAE

## Genus CAPROLAGUS Blyth

## CAPROLAGUS SINENSIS SINENSIS (Gray)

*Lepus sinensis* GRAY, Hardwicke's Illust. Indian Zool., vol. 2, 1833-34, pl. 20 (Canton, Kwangtung, China).

*Specimens*.—Seven from Kiangsu: Shanghai, 6, and Chinkingang, 1.

The Shanghai skins are very uniform but the one from Chinkingang is a bit darker and lacks any suggestion of gray upon the cheeks and about the base of the ears. I follow G. M. Allen (1927) in the generic disposition of this species.

## CAPROLAGUS SINENSIS FLAVIVENTRIS G. M. ALLEN

*Caprolagus sinensis flaviventris* G. M. ALLEN, Amer. Mus. Nov., No. 284, 1927, p. 5 (Chunganh sien, Fukien, China).

*Specimens*.—Three from Yo how, Hunan.

These skins have the underparts a bit more ochraceous and buffy than those from Shanghai, but the difference is very slight.

## Genus LEPUS Linnaeus

## LEPUS TOLAI TOLAI Pallas

*Lepus tolai* PALLAS, Nov. Spec. Quad. Glir. Ord., 1778, p. 17 (Gobi Desert, Mongolia).

*Specimens*.—Twelve: Mongolia, 100 miles north of Kalgan, Chihli, 1; Paotowchen and 93 and 107 miles west-northwest thereof, Inner Mongolia, 6; Sianfu, Shensi, 1; and 85 miles north of Lanchow, 2, and west of Sining, Kansu, 2.

The skins from north of Kalgan seem perfectly typical of the race *tolai*. Although unexpected, I have no choice but to include the Sianfu individual under this name. The material from Inner Mongolia is in very ragged, dirty, late winter pelage, paler and less yellow than summer skins. The specimens from Kansu are in even worse condition as to pelage. The validity of the races *gobicus* and *gansuicus* Satunin remains to be established but it is doubted that they will prove distinct.

## LEPUS TOLAI SUBLUTEUS Thomas

*Lepus swinhoei subluteus* THOMAS, Abst. Proc. Zool. Soc. London, 1908, p. 45 (Southern Ordos Desert, Mongolia).

*Specimens*.—Four: 20 miles west of Ningwufu, Shansi, 2 (including the type of *L. sowerbyae*); and 12 miles south of Yenafu, Shensi, 2.

Thomas (1908) was correct in stating that hares indistinguishable from *swinhoei* range west across southern Shansi and Shensi, while *subluteus* occurs over the northern parts of these provinces. Hollister assumed one of the dark-chested examples of the former to be *subluteus* during comparisons of the specimen which he described under the name *sowerbyae*. The type of the latter and a topotype, however, are indistinguishable from typical *subluteus* and the name must be placed in the synonymy of the latter. Sowerby found this hare to be common in mountainous and hilly country as well as on the plains.

## LEPUS TOLAI SWINHOEI Thomas

*Lepus swinhoei* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 13, 1894, p. 364 (Chefoo, Shantung, China).

*Specimens*.—Four: Tientsin, 1, and 65 miles northeast of Peking, Chihli, 2; and 80 miles west-southwest of Sianfu, Shensi, 1.

One of the specimens from northeast of Peking is a juvenile and considerably darker than the others. On the basis of the present material I can not recognize *filchneri* as a valid race.

## LEPUS TOLAI AURIGINEUS Hollister

*Lepus auriginus* HOLLISTER, Proc. Biol. Soc. Wash., vol. 25, 1912, p. 181 (probably Kiukiang, Kiangsi, China).

*Specimens*.—Six: Kiukiang, Kiangsi, 1 (the type); Shanghai, Kiangsu, 1; and Snifu, Szechwan, 4.

This race was based upon a subadult, imperfect skin having so much of the tail missing that the color of this member can not be told. The label bears merely the word China, but the museum catalogue gives the information that the locality was Chiu Keang, which may or may not be Kiukiang, Kiangsi, and the date of capture December 27, 1880. There is also in the national collection a companion skin of the identical poor make and with a similar label, being indistinguishable from the type save that the entire tail is present. The position of this specimen in the accession catalogue is upon the line preceding the one occupied by the type of *auriginus*. The locality is given as Shanghai (as it is upon the label), and the date of capture (not of accession) also December 27, 1880. Whether or not these two specimens were actually killed upon the same day in the province of Kiangsi or of Kiangsu, they are most certainly of

the same sub-species and identical in every respect. The upper surface of the tail of the Shanghai skin is black, which definitely places both with the species *tolai*, and the character of pelage, length of foot, and black ear markings corroborates the relationship. The anterior part of the nasals of the type has been broken off, which obviates the value of any observations upon this feature of the skull. The chief character of differentiation is the more ochraceous coloration, as already mentioned by G. M. Allen (1927).

The affinity of the Suifu specimens are with this race, although the two skins in good pelage are sufficiently darker to indicate that they may be subspecifically distinct: but these are flat skins without skulls. The soles of the feet are a veritable bright red, which may be a stain.

#### LEPUS TOLAI MANDSHURICUS Radde

*Lepus mandshuricus* RADDE, Reise Suden Ost-Sibirien, 1862, p. 215 (Bureja-Gebirge (Mountains), eastern Siberia).

*Specimen*.—One from near Imienpo, Manchuria.

This race is much darker than *tolai typicus* because of the greater number of black guard hairs. The suggestion of pink in the pelage is very characteristic.

#### LEPUS GRAHAMI A. B. Howell

*Lepus grahami* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 143 (Ulongkong, south of Tatsienlu, Szechwan, China).

*Specimens*.—Ten from Szechwan: five from the type locality and its vicinity, and five from near Sungpan.

This large, dark, slaty, mountain hare is very striking but is doubtless subspecifically related to *L. comus*.

## Order ARTIODACTYLA

### Family SUIDAE

#### Genus SUS Linnaeus

In the classification of the Chinese pigs I follow Sowerby.<sup>3</sup> For his study he had a far greater number of skulls than skins, while in the present representation there is a preponderance of skins.

#### SUS MOUPINENSIS Milne-Edwards

*Sus moupinensis* MILNE-EDWARDS, Nouv. Arch. Mus., vol. 7, 1871, p. 93 (Muping, Szechwan, China).

*Specimens*.—Seven: Yenanfu, 1, and 100 miles northwest of Sianfu, Shensi, 1; 20 miles west of Ningwufu, 1, 50 miles west of Fenchowfu, 1, and 50 miles northwest of Taiyuanfu, Shan-si, 3.

<sup>3</sup> Proc. Zool. Soc. London, 1917, p. 7.

Sowerby has indicated that the Shansi pigs may be distinct from those of Shensi. Unfortunately the above Shensi specimens consist of a young pig, and an old boar in the excessively short, worn, pale coat sometimes met with and is useless for color comparison. Of the remaining material four are pigs of good size in splendid coat, which is distinctly paler than in *Sus paludosus*.

**SUS PALUDOSUS Heude**

*S[us] paludosus* HEUDE, Mems. Hist. Nat. Emp. Chinois, vol. 3, 1896, p. 193 (Kiangyin River at Nanking, Kiangsu, China).

*Specimens*.—Six: Yochow, Hunan, 2; near Chinkiang, Kiangsu, 1; Ningpo district, Chekiang, 2; and Peiliang, Fukien, 1.

The specimen from Kiangsu is a virtual topotype and is an adult female. The Yochow examples are immature and are not quite so red as the two specimens, of similar age, from the Ningpo district. The status of *Sus meles* is uncertain, as it is known only by a single skull with dentition that is probably not normal.

**SUS GIGAS Heude**

*Sus gigas* HEUDE, Mems. Hist. Nat. Emp. Chinois, vol. 2, 1892, p. 87 (Vladivostok, Siberia).

*Specimen*.—One from Imienpo, Manchuria.

This specimen is an exceedingly large sow in good coat which is slightly darker than in *paludosus*, but much darker than in *moupinensis*.

**Family CERVIDAE**

**Genus MOSCHUS Linnaeus**

**MOSCHUS SIFANICUS Büchner**

*Moschus sifanicus* BÜCHNER, Mém. Biol. Acad. St. Petersb., vol. 12, 1890, p. 162 (southern Kansu, China).

*Specimens*.—Seven: Taochow, 2, and Archuen, Minshan Mountains, Kansu, 4; and Taipeishan, Shensi, 1.

It is not unlikely that the type of this species came from somewhere in the neighborhood of the Minshan Mountains. Five of the above skins are fairly uniform except for the coloration of the ears. The skin from Shensi and one of those from Archuen, however, are considerably different, being darker and with paler, better defined neck stripes, and with rump and hind legs almost black. Without a better understanding of the normal variation within the musk deer of China than the present material permits, their separation would be unjustified.

**MOSCHUS PARVIPES Hollister**

*Moschus parvipes* HOLLISTER, Proc. Biol. Soc. Wash., vol. 24, 1911, p. 1 (below Mokpo, Korea).

*Specimen*.—One—the type.

## Genus MUNTIACUS Rafinesque

It seems extremely likely that Lydekker (1915) recognized a greater number of races of muntjac than warrantable, and the material at my disposal leads me to believe that there are not two distinct species (*reevesii* and *lachrymans*) occupying the same districts over much of south China. The final question of the proper nomenclature to employ must, however, be left to someone having access to a large collection.

## MUNTIACUS REEVESII REEVESII (Ogilby)

*Cervus reevesii* OGILBY, Proc. Zool. Soc. London, 1838, p. 105 (Canton, Kwangtung, China).

*Specimens*.—Five: Yochow, Hunan, 2; Futsing, Fukien, 2; and Chekiang, 1.

Lydekker (1915) lists races of two species—*M. lachrymans sclateri* and *M. reevesii reevesii*—from both Foochow and Ningpo. These are differentiated by characters which I do not consider altogether reliable, some of them probably varying with the individual and others with age, and even sex. The male and female from Fukien match one of these forms in certain respects, and the second in still others. The prior specific name—*reevesii*—is therefore used for all three individuals. Their skulls do not differ in any important characters: the nasals of all are expanded caudad of the maxillary juncture, and the lachrymal pits proper, slightly smaller than the orbits, do not quite occupy the whole lachrymal bone. The horns of the adult male project but 15 mm. beyond the integument. In both Fukien skins, taken on March 8 and 9, the dorsal color is the same shade of bright reddish ochraceous, the female being grayer on the sides. The latter has a narrow nuchal stripe, black forehead and dusky ears. The male has a yellow forehead and ears and practically no nuchal stripe. All of these points, possibly with the exception of ear color, are usual sexual differences of this genus. Both examples have pale buffy throats. The Ningpo skin is of a female taken in January and is much darker and duller, with darker throat, brown ears, and extensive dark forehead area. The latter differences may be subspecific and not largely ascribable to seasonal variation, but evidently no existing name may be used for it unless it be one of the above, and it is thought better for the present to assign all three to the same race. The Hunan skins are very similar.

## MUNTIACUS REEVESII LACHRYMANS (Milne-Edwards)

*Cervulus lachrymans* MILNE-EDWARDS, Arch. Mus. Paris, vol. 7, 1871, p. 93 (Muping, Szechwan, China).

*Specimens*.—Eleven from Szechwan; Suifu, 4; Mount Omei, 6; and Washan, 1.

Szechwan specimens of muntjac in good coat are considerably brighter than the two individuals of the race *sclateri*, and the brighter parts of the head markings are more reddish. From typical *reevesii* they differ very slightly, the most trustworthy detail apparently being the greater broadness of the black superciliary marks in the males; and the legs also average a bit darker. I can distinguish no skull differences in this material and, in fact, consider the race a poor one; but it may be recognized under this name largely for the sake of expediency.

**MUNTIACUS REEVESII SCLATERI (Swinhoe)**

*Cervulus sclateri* SWINHOE, Proc. Zool. Soc. London, 1872, p. 814 (Ningpo, Chekiang, China).

*Specimens*.—Two from Kiangsu; Soochow, 1, and Chekiang, 1.

These specimens are readily separable from true *reevesii*, as I understand the latter, and the above name is the one that should be used for them. They are without date so the difference in body color may possibly be seasonal; but at any rate the coat is considerably duller and browner (less red), and the brighter part of the forehead of the male is paler than in any comparable *reevesii*. The base of the rostrum is also relatively broader, so that the outline from the premaxillae to the zygomatic arches is almost straight, instead of much curved as in every other skull of the genus available.

**Genus ELAPHODUS Milne-Edwards**

**ELAPHODUS CEPHALOPHUS Milne-Edwards**

*Elaphodus cephalophus* MILNE-EDWARDS, Arch. Mus. Paris, vol. 7, 1871, p. 93 (Muping, Szechwan, China).

*Specimens*.—Three from Szechwan; Wenchwan, 2 and Mount Oilei, 1.

**Genus CERVUS Linnaeus**

**CERVUS (SIKA) MANTCHURICUS Swinhoe**

*Cervus mantchuricus* SWINHOE, Proc. Zool. Soc. London, 1864, p. 169 (Manchuria).

*Specimens*.—Three from Korea.

The coloration of the metatarsal glands is not constant in this group but varies, perhaps, with age or season.

**CERVUS KANSUENSIS Pocock**

*Cervus kansuensis* Pocock, Proc. Zool. Soc. London, 1912, p. 573 (30 miles southeast of Taochow, Kansu, China).

*Specimens*.—Twelve: near Taochow, Kansu, 6; and west of Kueihuacheng, Shansi, 6.

I am not in a position to form an opinion in regard to the validity of this race of stag. There is a good deal of uniformity in the body color in respect to season, but considerable variation in the nuchal stripe and in rump marking. In animals from the same locality the black of the upper rump may extend to the tail tip, or again the whole of the lower rump above the tail may be whitish, or of an intermediate character.

**CERVUS XANTHOPYGUS** Milne-Edwards

*Cervus xanthopygus* MILNE-EDWARDS, Ann. Sci. Nat. Paris, vol. 5, p. 8, 1869, p. 376 (probably the Ussuri district, Manchuria).

*Specimens*.—Three from Imienpo, Manchuria.

This form is very distinct from *kusuensis*, with a reddish tone which the latter lacks. An immature is as red as any *Capreolus*.

**Genus ELAPHURUS** Milne-Edwards

**ELAPHURUS DAVIDIANUS** Milne-Edwards

*Elaphurus davidianus* MILNE-EDWARDS, Ann. Sci. Nat. Paris, vol. 5, pt. 5, 1866, p. 380 (Peking, Chihli, China).

The National collection contains a mounted specimen and skull without horns (possibly the same individual) from Woburn Abbey.

**Genus CAPREOLUS** Gray

**CAPREOLUS BEDFORDI** Thomas

*Capreolus bedfordi* THOMAS, Abst. Proc. Zool. Soc. London, 1903, p. 32 (100 miles northwest of Taiyuanfu, Shansi, China).

*Specimens*.—Seven: 50 miles west of Fenchowfu, 2, and Kneihua-cheng, Shansi, 1; 12 miles south of Yenanku, Shensi, 2; Hsinlungshan, Chihli, 1; and a single specimen from an unknown locality.

The relationship of the different forms of Asiatic roe deer is imperfectly understood and for the present they may be treated as full species. None of these specimens exhibits any tendency toward the blackening of the ears that is characteristic of *melanotis*.

**CAPREOLUS MELANOTIS** Miller

*Capreolus melanotis* MILLER, Proc. Biol. Soc. Wash., vol. 24, 1911, p. 231 (30 miles east of Chingyangfu, Kansu, China).

*Specimen*.—One—the type.

**CAPREDLUS PYGARGUS** (Pallas)

*Cervus pygargus* PALLAS, Reise Russl., vol. 1, 1777, p. 97 (Altai, Siberia).

*Specimen*.—One from Imienpo, Manchuria.

This September skin is still in the summer coat, which is of the brown type and rather dark—not the red type characteristic of

the two previous forms. It is probably not typical but seems to be nearer *pygargus* than anything else that has been described.

### Genus HYDROPOTES Swinhoe

#### HYDROPOTES INERMIS INERMIS Swinhoe

*Hydropotes inermis* SWINHOE, Proc. Zool. Soc. London, 1870, p. 89 (Chinkingang, Kiangsu, China).

*Specimens*.—Thirteen: Yochow, Hunan, 10; Anhwei, 1; Soochow, 1, and Chinkingang, Kiangsu, 1.

This fine series shows that there is much individual variation in color, and in size of skull, within this genus.

#### HYDROPOTES INERMIS ARGYROPUS Hilzheimer

*Hydropotes argyropus* HILZHEIMER, Abhand. Mus. Naturk., Magdeburg, vol. 1, 1906, p. 171 (Korea).

*Specimens*.—Eleven: from Korea, 5 odd skulls and 4 odd skins, and 2 from north China or Manchuria.

Heude was the originator of this racial name but his use of it constituted a nomen nudum and Hilzheimer seems to be the one who should be credited with its acceptable use. The form is recognized on the basis of average darker and richer coloration, with more reddish about the head. The skull exhibits no consistent differences. The disposal of the two skins from uncertain localities is a question, and they are allocated provisionally. They are in extremely heavy, pale, winter pelage and are very different from any of the others, which may be due entirely to season.

## Family BOVIDAE

### Genus OVIS Linnaeus

#### OVIS AMMON AMMON (Linnaeus)

*Capra ammon* LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 97 (Upper Irtysh River, Siberia).

*Specimens*.—Four, from near Tchegan-Burgazi Pass, Mongolia.

These skins were purchased in Kosh-Agatch. Two are in pale gray and very short summer coat and two in heavy winter pelage. One of these is rather light and the other very dark indeed, with a middorsal stripe that becomes perfectly white below the withers. I can hardly believe that these two are of the same subspecies but as one cannot be certain where they were secured they must both be placed under this race for the present.



## OVIS AMMON KOZLOVI Nasonov

*Ovis kozlovi* NASONOV, Bull. Acad. Imp. Sci. St. Petersburg, 1913, p. 621 (Jabarai Mts., southern Gobi, Mongolia).

*Specimens*.—Five from Kueihuacheng, Shansi.

This race seems to be tenable, based chiefly on the dingy hue, rather than a pure white, of the rump patch. The summer pelage is unusually rusty.

## Genus PSEUDOIS Hodgson

## PSEUDOIS NAYAUR CAESIA A. B. Howell

*Pseudois nayaur caesia* A. B. HOWELL, Proc. Biol. Soc. Wash., vol. 41, 1928, p. 118 (Archuen, Minshan Range, Kansu, China).

*Specimens*.—Archuen, 1 (the type), and Ninghsia, Kansu, 4; and 157 miles west-northwest of Paotowchen, Inner Mongolia, 3.

It was only to be expected that the bharal of Kansu would prove to be a separable race.

## Genus CAPRICORNIS Ogilby

## CAPRICORNIS MILNE-EDWARDSI David

*Capricornis milne-edwardsi* DAVID, Arch. Mus. Paris, vol. 5, 1869, p. 10 (Muping, Szechwan, China).

*Specimens*.—Three: Tibetan border of Kansu, 2; and Washan, Szechwan, 1.

In the light of present knowledge it seems that all three of these specimens of serows must be listed under this name. The presence or absence of a black stripe upon the foreleg evidently means but little, for one Kansu individual has it and the other has not. The hairs of the rump of the Washan skin are tipped with black, a character which the others lack. It seems that the white hairs of the mane, which is not extensive in these pelts, are coarser and more brittle than the remainder of the pelage and that the tips are prone to breakage; hence the presence or absence of a mane is largely seasonal.

## Genus NAEMORHEDUS H. Smith

## NAEMORHEDUS CAUDATUS (Milne-Edwards)

[*Antelope*] *caudata* MILNE-EDWARDS, Ann. Sci. Nat., ser. 5, vol. 7, 1867, p. 377 [Based on:—*Antelope crista* Radde, 1862, Reisen im Süden von Ost-Sibirien, vol. 1, Die Säugethierfauna, St. Petersburg, p. 263; Amur].

*Naemorhedus caudatus* MILNE-EDWARDS, Rech. Mamm., 1874, p. 361 (Mongolia).

*Specimens*.—Three: Kueihuacheng, Shansi, 1; Liutsuen, Shensi, 1; and Wenchwen, Szechwan, 1.

These three pelts show such a mixture and intergradation of the characters that are usually assigned to *caudatus* and to *griseus* that I must provisionally place them under the older name.

**NAEMORHEDUS RADDEANUS (Heude)**

*Canis raddeanus* HEUDE, Mem. Hist. Nat. Emp. Chinois, vol. 2, 1894, p. 240 (Ussuri, Manchuria).

*Specimens*.—Two from Imienpo, Manchuria.

These pelts are easily distinguished by the dirty whitish instead of black tail tip, the greater extent of black upon the fore legs, and by the heavier pelage. Greater size seems also indicated.

**Genus BUDORCAS Hodgson**

**BUDORCAS TIBETANUS Milne-Edwards**

*Budorcas tataricolor* var. *tibetanus* MILNE-EDWARDS, Rech. Mamm., 1874, p. 367 (Muping, Szechwan, China).

*Specimens*.—One mounted example from Tatsienlu, Szechwan.

**BUDORCAS BEDFORDI Thomas**

*Budorcas bedfordi* THOMAS, Abst. Proc. Zool. Soc. London, 1911, p. 27 (Taipeishan, Shensi, China).

*Specimen*.—One from Taipeishan district, Shensi.

This topotype seems to be an exact match for the figure given by Thomas.

**Genus GAZELLA Lichtenstein**

**GAZELLA PRZEWALSKII Büchner**

*Gazella przewalskii* BÜCHNER, Mém. Biol. Acad. Sci. St. Petersb., vol. 13, 1890, p. 161 (Mongolia).

*Specimens*.—Four: 80 miles south-southwest of Ninghsia, Kansu; and 157 miles west-northwest of Paotowchen, Inner Mongolia.

Skins of this species are readily distinguished from those of *G. gutturosa* chiefly by the longer black tail, tufted forelegs, much duller color, and differences in facial markings. Two are in summer and two in winter coat.

**GAZELLA GUTTUROSA (Pallas)**

*Antilope gutturosa* PALLAS, Spicil. Zool., vol. 12, 1777, p. 46 (Mongolia).

*Specimens*.—Seven from the vicinity of Tabul, Chihli.

These are in summer coat and the bright coloration is very uniform.

## Order EDENTATA

### Family MANIDAE

#### Genus MANIS Linnaeus

##### MANIS DALMANNI Sundevall

*Manis dalmanni* SUNDEVALL, Vetense. Akad. Handl., 1842, p. 256 (Canton, Kwangtung, China).

*Specimen*.—One from Foochow, Fukien.

The Chinese members of this genus are in need of revision. Pocock (1924) has cleared up generic questions, but the literature seems to offer little to elucidate the relationships of *dalmanni*, *aurita*, and *pentadactyla*. The above skin, however, matches the descriptions of the first-mentioned form and not the others. Longitudinal rows of scales number 15, and there are 19 keeled scales upon the border of the tail.

##### MANIS AURITA Hodgson

*Manis aurita* HODGSON, Journ. Asiatic Soc. Bengal, vol. 5, 1836, p. 234.

*Specimen*.—One from Yunnan, bought between Tengyueh and Yunlung, undoubtedly from either the Salween or Mekong river valley.

This dried specimen has a present total length of 470 mm. The claws are of the same color as the scales, the latter are not keeled on the flanks and are arrayed in 15 rows over the back, while the keeled scales of the tail border number 17.

## Order CETACEA

### Family ODONTOCETI

#### Genus LIPOTES Miller

##### LIPOTES VEXILLIFER Miller

*Lipotes vexillifer* MILLER, Smiths. Misc. Coll., vol. 68, 1918, p. 8 (Tungting Lake, Hunan, China).

*Specimen*.—One—the type.

#### Genus NEOMERIS Gray

##### NEOMERIS PHOCAENOIDES (Cuvier)

*Delphinus phocaenoides* CUVIER, Reg. Anim., 1829, p. 291.

*Specimens*.—Eight from Kiangsu: one skin and skeleton from Whangpu River; one in spirits from Whangpu Creek; another from the Yangtze River; and three more in spirits and two skeletons from Woosung. In addition, the skeleton has been removed from one of the last mentioned individuals.

These specimens have been discussed elsewhere.<sup>4</sup>

<sup>4</sup> Howell, Proc. U. S. Nat. Mus., vol. 70, 1927, art. 13, pp. 1-43.

## EXPLANATION OF PLATES

## PLATE 1

## Frontispiece

Map showing the provinces of China, after the atlas of the China Inland Mission.

## PLATE 2

*a*, *Crocidura grisea*, type; *b*, *Crocidura dracula grisea*, type; *c*, *Hipposideros armiger sichhoii*; *d*, *Hipposideros pratti*; *e*, *Coelops robinsoni*; *f*, *Coelops inflatus*, type; *g*, *Myotis hirsutus*, type; *h*, *Myotis sowerbyi*, type; all natural size.

## PLATE 3

*a*, *a*<sup>1</sup>, *Ochotona (Ochotona) erythrotis vulpina*, type; *b*, *b*<sup>1</sup>, *Ochotona (Pika) alpina argentata*, type; both natural size; *c*, *Lepus tolai subluteus*; *d*, *Lepus grahami*, type; both slightly reduced.

## PLATE 4

*a*, *a*<sup>1</sup>, *Petaurista sulcatus*, type, natural size; *b*, *Pseudois nayaur caesia*, type, greatly reduced.

## PLATE 5

*Pithecus pullus*, type, one-half natural size.

## PLATE 6

Dorsal aspect of the skull of the type of *Selenarctos thibetanus wulsini*, one-half natural size.

## PLATE 7

Palatal aspect of the skull of the type of *Selenarctos thibetanus wulsini*, one-half natural size.

## PLATE 8

Dorsal aspect of the skull of an adult *Ursus cavifrons*, two-fifths natural size.

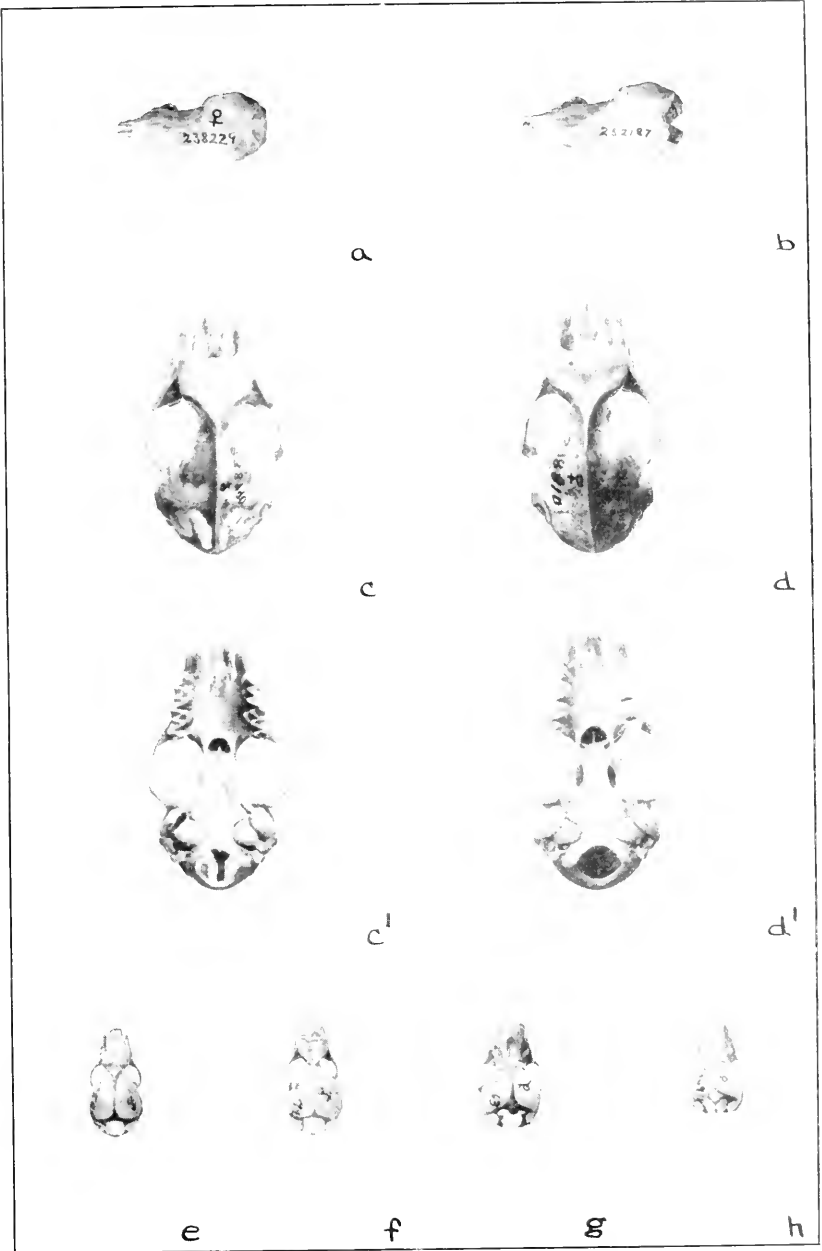
## PLATE 9

Palatal aspect of the skull of an adult *Ursus cavifrons*, two-fifths natural size.

## PLATE 10

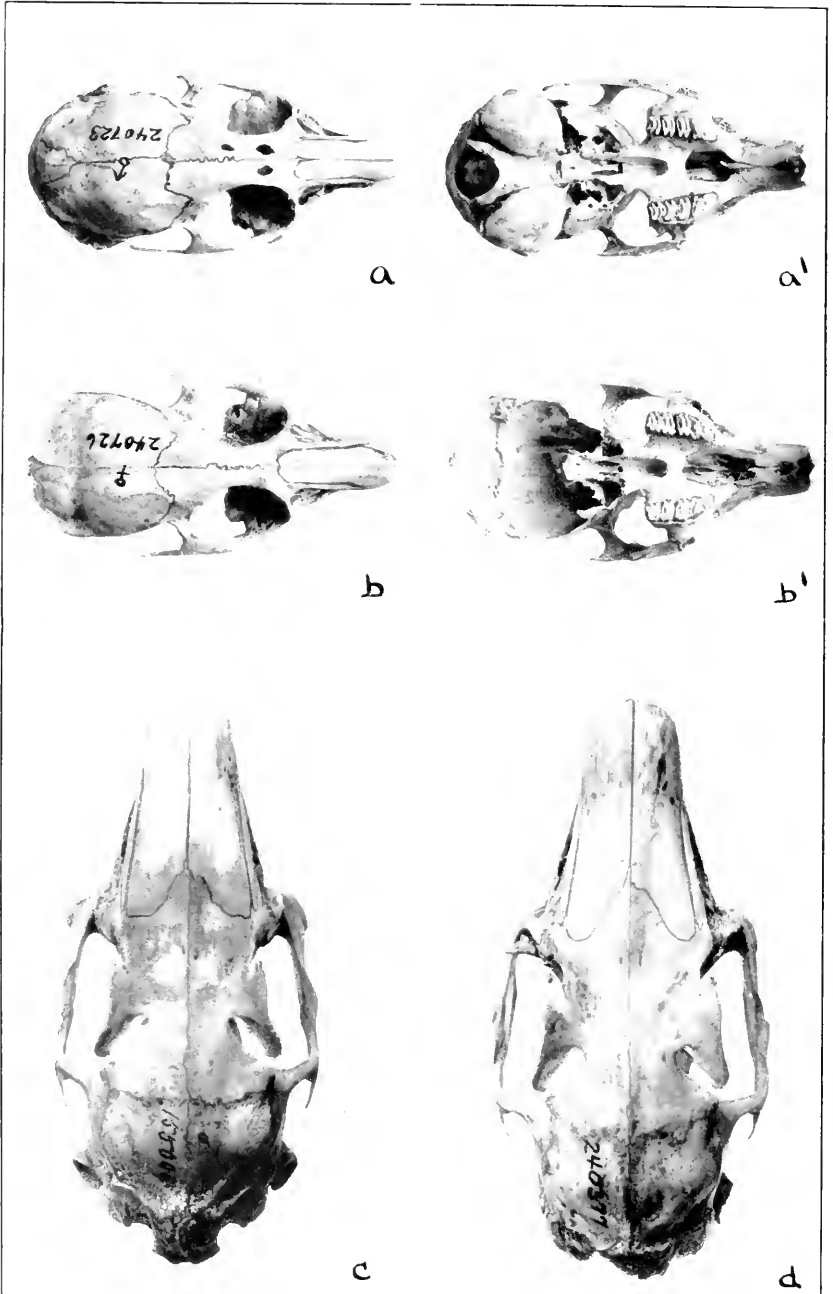
Palatal aspect of the skull of a juvenal *Ursus leuconyx*, one-half natural size.





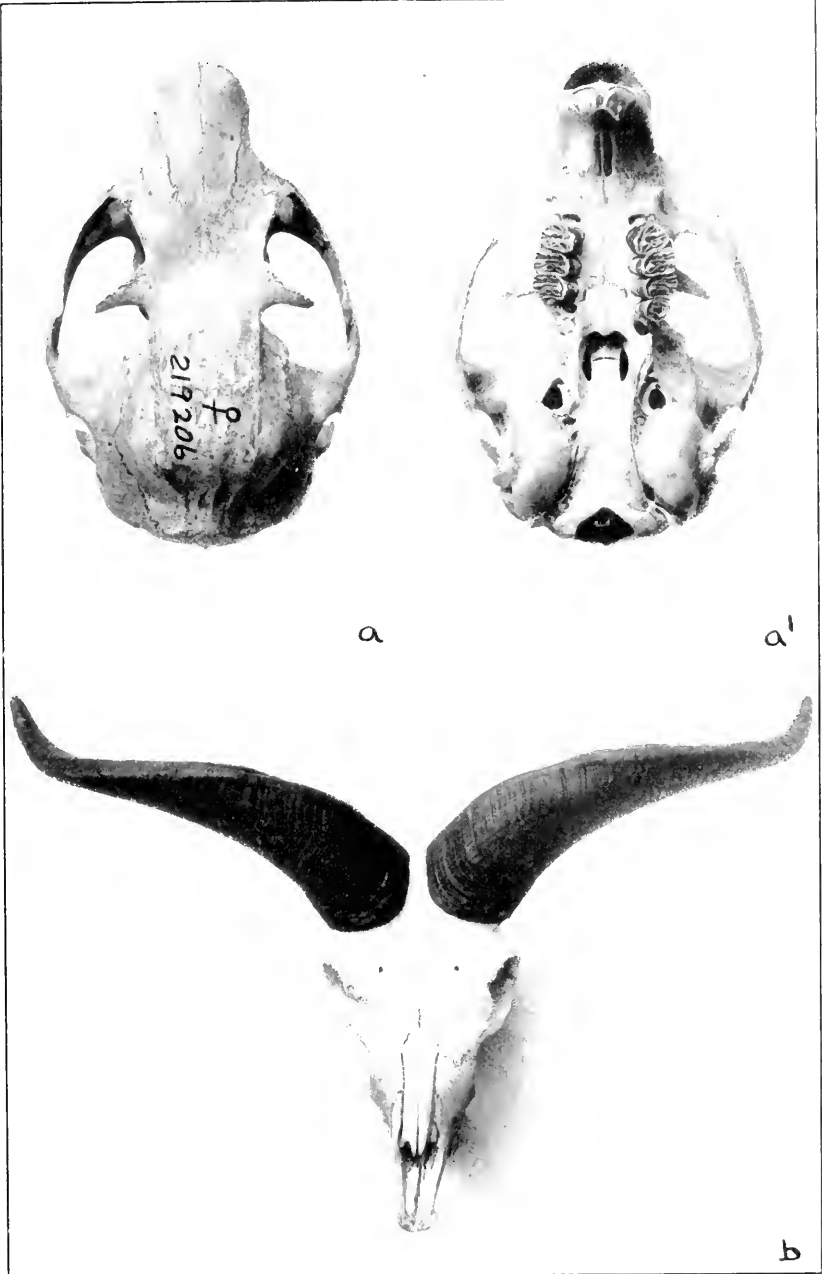
SKULLS OF CHINESE SHREWS AND BATS

FOR DESCRIPTION SEE PAGE 82



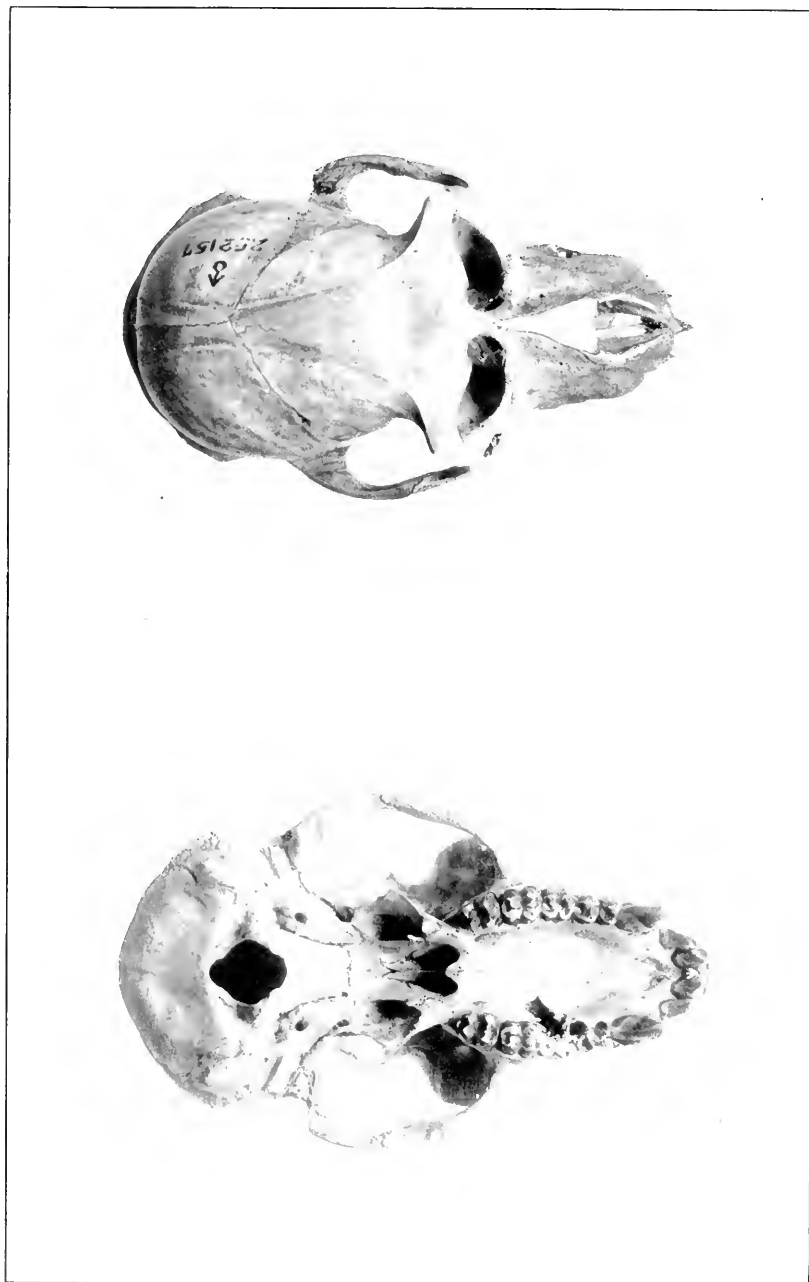
SKULLS OF CHINESE PIKAS AND HARES

FOR DESCRIPTION SEE PAGE 82



SKULLS OF CHINESE FLYING SQUIRREL AND SHEEP

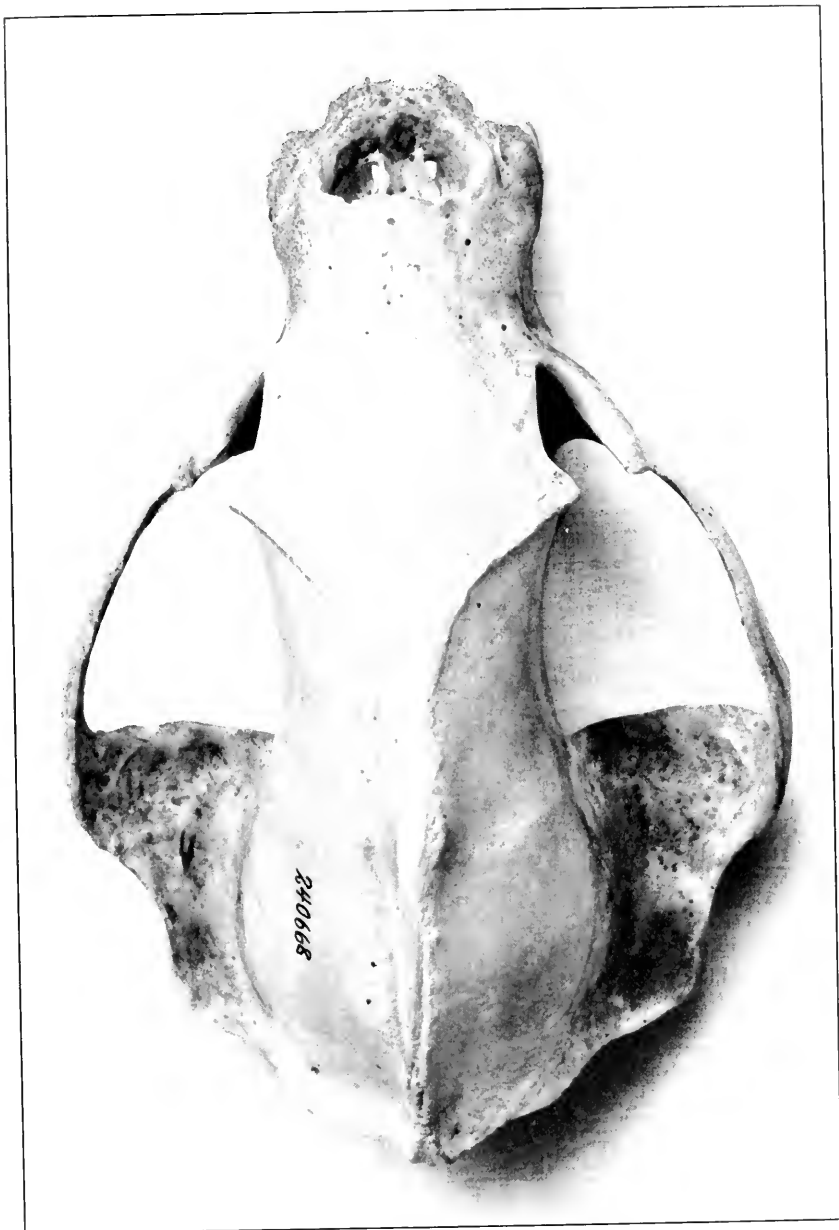
FOR DESCRIPTION SEE PAGE 82



SKULL OF PITHECUS PULLUS, TYPE

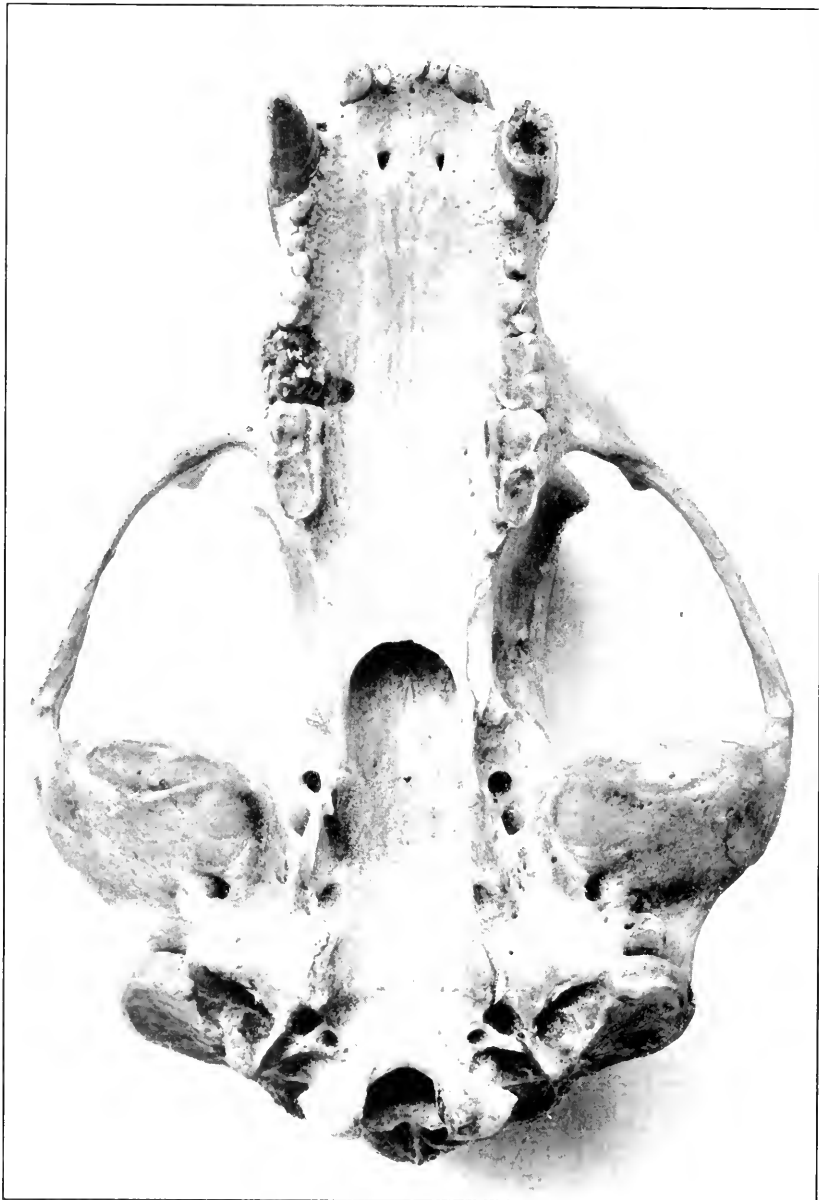
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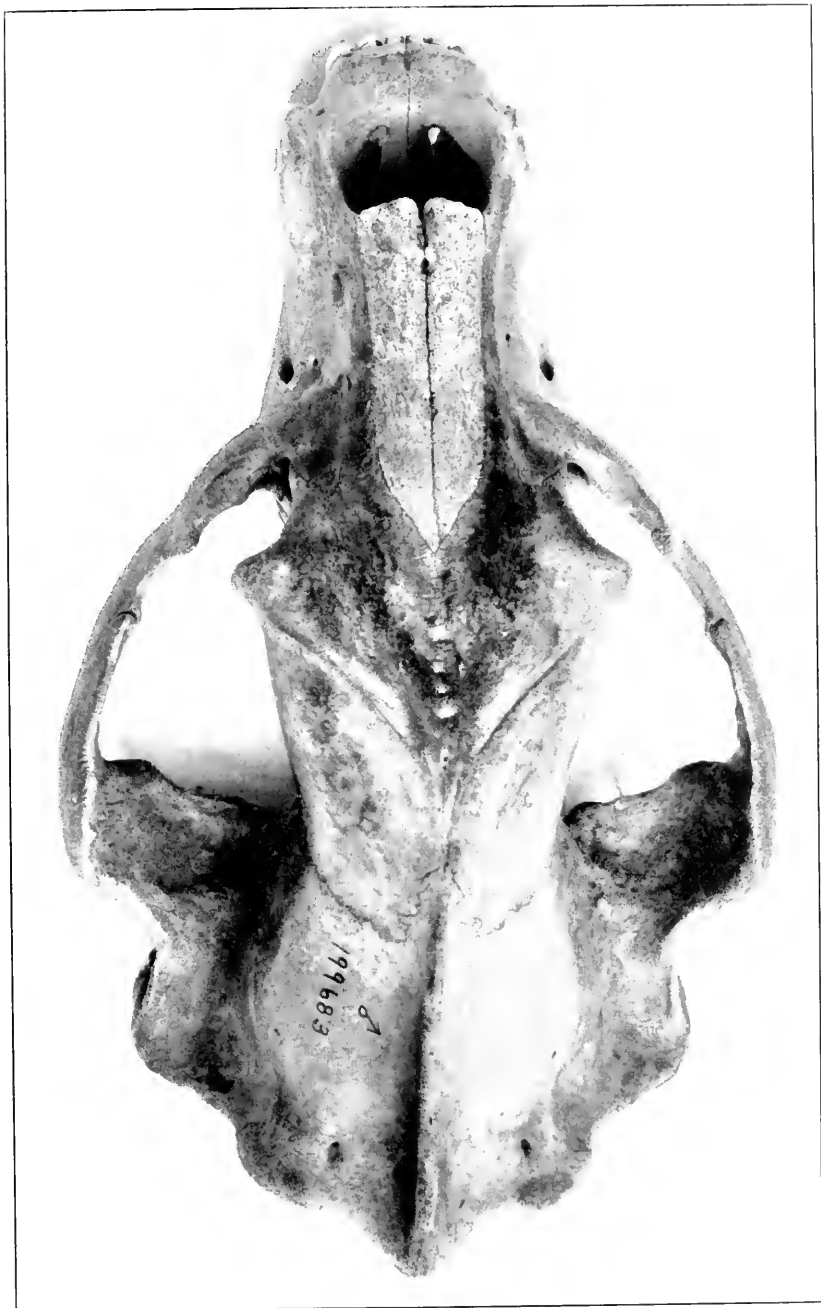
SKULL OF SELENARCTOS THIBETANUS WULSINI. TYPE

FOR DESCRIPTION SEE PAGE 82



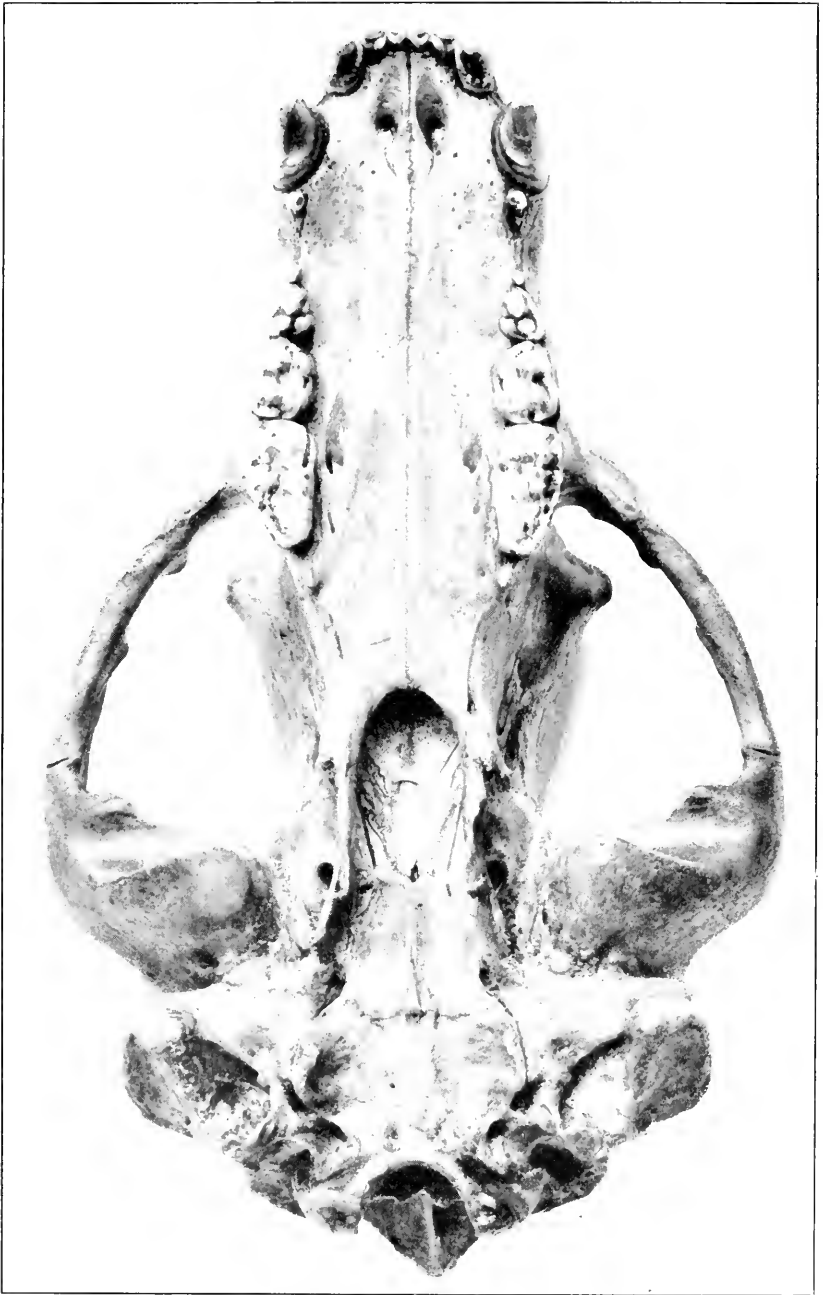
SKULL OF *SELENARCTOS THIBETANUS WULSINI*, TYPE

FOR DESCRIPTION SEE PAGE 82



SKULL OF *URSUS CAVIFRONS*

FOR DESCRIPTION SEE PAGE 82



SKULL OF *URSUS CAVIFRONS*

FOR DESCRIPTION SEE PAGE 82



SKULL OF YOUNG *URSUS LEUCONYX*

FOR DESCRIPTION SEE PAGE 82



# BEETLE LARVAE OF THE SUBFAMILY GALERUCINAE

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## INTRODUCTION

The present paper is the result of a continued investigation of the Chrysomelid larvae in the United States National Museum, Washington, D. C. Of the subfamily Galerucinae<sup>1</sup> belonging to this family the larvae are preserved in the Museum of the following species:

- Monocesta coryli* Say.  
*Trirhabda canadensis* Kirby.  
*Trirhabda brevicollis* LeConte.  
*Trirhabda nitidicollis* LeConte.  
*Trirhabda tomentosa* Linnaeus.  
*Trirhabda attenuata* Say.  
*Galerucella nymphaeae* Linnaeus.  
*Galerucella lineola* Fabricius (from Europe).  
*Galerucella sagittariae* Gyllenhal.  
*Galerucella laticola* Müller.  
*Galerucella* sp. (from Nanking, China).  
*Galerucella viburni* Paykull (from Europe).  
*Galerucella decora* Say.  
*Galerucella notata* Fabricius.  
*Galerucella cribrata* LeConte.  
*Monoxia puncticollis* Say.  
*Monoxia consputa* LeConte.  
*Lochmacea capreae* Linnaeus (from Europe).  
*Galeruca tanacetii* Linnaeus (from Europe).  
*Galeruca laticollis* Sahlberg (from Europe).  
*Galeruca pomonae* Scopoli.  
*Sernylassa halensis* Linnaeus.  
*Agclastica alni* Linnaeus.<sup>2</sup>

<sup>1</sup>The generic and specific names of the North American larvae are as listed in C. W. Leng's "Catalogue of Coleoptera of America north of Mexico, 1920," with corrections and additions as given in the "supplement" to the catalogue published by C. W. Leng and A. J. Mutchler, 1927. The European species, not introduced into North America, are named according to the "Catalogus Coleopterorum Europae, second edition, 1906," by L. v. Heyden, E. Reitter, and J. Weise.

<sup>2</sup>It will be noticed that in the enumeration above no species of *Diabrotica* and *Phyllobrotica* are mentioned. The larvae of these genera were considered by the present author as Malticinae larvae [Böving, Adam G. Description of larvae of the genera *Diabrotica* and *Phyllobrotica*, etc., Proc. Ent. Soc. Wash., vol. 29, 1927, pp. 193-205.]

Based on this material, a general characterization of the larvae of the Galerucinae has been worked out, and illustrated descriptions are given of the species mentioned. Preceding these descriptions is a key to the larvae (p. 8), and the paper is brought to an end (p. 40) with a discussion of the taxonomy of the subfamily.<sup>3</sup>

#### ACKNOWLEDGMENT

Several of the descriptions in the present paper, particularly of unintroduced European larvae, are based on material generously donated to the United States National Museum by the Danish entomological writers, Messrs. E. A. Rosenberg and J. P. Kryger, whose extraordinary ability in the collecting, rearing, and determining of coleopterous larvae are greatly appreciated in entomological circles, both in Europe and America. The American friends of the National Museum, the prominent entomologist, Dr. George Dimmock, and Mr. E. M. Craighead who has made a special study of chrysomelid larvae, have also donated Galerucinae larvae of great interest not formerly represented in the collections. Detailed information about these specimens will be found where the species are described.

#### CHARACTERIZATION OF LARVAL TYPE OF GALERUCINAE

Larva generally of medium size ranging in length between 7 and 15 mm., elongate with small head and a moderately large pygidial shield; without urogomphi (= cerci); body with subparallel sides, but somewhat attenuated both toward the head and the last segment, under side of body rather flat and not fully as long as the upper side. Segments soft skinned, mostly of the same height and width, on each side of the body with one or two small, setae bearing sclerites in all of the areas. Color varying depending upon the dimensions and shade both of the sclerites and the skin between (figs. 4, 7, 9); underside of the body generally lighter than the upper side.

Setae usually moderately long and pointed on the head capsule, the mouth parts, the prothoracic and pygidial shields and the legs; of very different lengths and shapes on the body sclerites, varying from minute to long and from pointed to capitate; inserted either irregularly or in transverse rows on the surface of the sclerites or radiating from a cone-shaped prolongation of the sclerites. (Figs. 10 to 13.)

Head capsule strongly chitinized, shining, hypognathous; frons never extending to the occipital foramen, a distinct, usually long

<sup>3</sup>No larvae are known from North America representing the tribes Scoldini, with genus *Seclolyperus*, Luperini, with genus *Luperodes*, Androlyperini, Metaacyclini, and Cerotomini with genus *Cerotoma*, all of which are listed as Galerucinae according to the imagines.



median epicranial (= coronal) suture always present; epicranial halves not produced posteriorly, except in the mining larva of *Monoxia consputa*. (Fig. 40.) Ocelli always present; only one on each side, distinct, with strongly convex cornea and about of the same size as one of the spiracles. Antenna short, retractile, consisting of a single joint seated in a large basal membrane; a jointlike, well developed tactile papilla and several minute, pointed sensory organs located in the membranous top of the antennal joint. (Fig. 36.)

Labrum and clypeus well developed and distinct. Clypeus whitish and soft skinned, with a chitinous plate at each hind corner carrying a series of about four small or minute setae. Labrum well chitinized, subrectangular to semicircular, with or without a median anterior emargination, exceptionally in *Monesta coryli* (fig. 35) subtriangular, with length and width about equal; medio-transversely a single row of four discal setae, two on each side; a few sensory punctures between or near the setae; along the frontmargin a series of several marginal setae, usually of very small size, the exterior two or three, however, somewhat larger than the rest, exceptionally with all marginal setae of moderate length (fig. 35).

Mandible (text fig. 1) strong, palmate, hollow toward the buccal cavity, terminally with from three to five teeth arranged in a series like fingers. First tooth (1) small, with the tip normally extending only slightly beyond the base of second tooth; third tooth, as a rule, the largest, in *Monocesta coryli* (figs. 45, 48) having a long, straight, serrated inner margin, but in all other Galerucinae larvae more claw shaped like the rest of the teeth. Inner edge of mandible behind the base of the last tooth often blade shaped and anteriorly projecting like a heel or a (sixth) tooth (*pr*). Penicillus (*pn*) present in some, absent in others, of the genera. Two setae (*se*) normally present on the dorso-exterior surface.

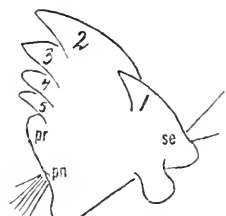


FIG. 1.—DIAGRAM OF MANDIBLE. FOR LETTERING SEE TEXT

Maxilla (figs. 56, 59, 61, 63) provided with two well developed, usually distinct lobes of about the same size, one posterior, here interpreted as lacinia, one anterior, here interpreted as galea; both lobes strengthened at base by a narrow bandlike prolongation of the ventral chitinized side of stipes. Lacinia located in the buccal cavity and to be found only by dissection (fig. 61), generally soft skinned and armed with setae varying in number, arrangement, size, and shape according to species or genus. Galea either entirely soft-skinned or distally chitinized like a single joint with a soft-skinned tip; several setae placed irregularly at the inner margin of galea; between these a short conical papilla with a basal ring (*ga\**). Max-

illary palpus short, four-jointed (three-jointed in *Galerucella nymphaeae* and *Monoxia consputa*), the basal joint crescent shaped or almost closed-ring shaped, usually carrying two long, strong setae and having two retractor muscles attached to the wall of the well-chitinized stipes and extending through the soft, whitish palpiger which is characterized by its lack of individual muscles. (Fig. 61.) Eulabium (fig. 63*b*) posteriorly limited by a chitinous postlabial band bent in a single or double arch. Labial palpus two-jointed, palpi inserted well apart, at a distance from each other somewhat longer than the length of one of the palpi, except in *Agelastica alni* where they are closer together. (Fig. 73.) Ligula short and thick, with moderately long setae.

Epipharynx (fig. 35) soft, beset with fine, short hairs.

Hypopharynx (fig. 61) soft, distally with pointed, papilliform hairs arranged in a patch inside of each lacinia; no median transverse bridge; no paragnaths; hypopharyngeal rods present, anteriorly reaching very close to or fused completely with the ends of the band-shaped chitinization at the bases of the maxillary lobes (fig. 64).

Prothorax (figs. 3, 21) dorsally with a rather large, often irregularly grooved and pitted saddle-shaped shield usually marked medially by a light sagittal suture. Setae often long, arranged as marginal setae in one or more series around the whole shield and as discal setae in small number in the central portion of it. Entire tergum covered by the shield except for a soft-skinned, narrow region following the outline of the shield and a soft-skinned, small, sub-triangular area<sup>4</sup> located immediately behind the head, above the ventro-lateral sulcus and in front of the oblique dorso-lateral sulcus. Epipleural area behind the dorso-lateral and above the ventro-lateral sulcus, triangular in form, with or without a setae-bearing sclerite in the middle. Hypopleural area below ventro-lateral sulcus, covered by a well-developed prehypopleural and a well-developed posthypopleural sclerite (= "episternum" and "epimeron" of authors). Sternal region divided into the following areas: Eusternum, sternellum (= "furcasternum" of authors), parasternum, and poststernellum (= "spinisternum"). Eusternal area with a median unpaired sclerite; sternellar area with a sclerite on each side of the middle line, eusternal and sternellar sclerites usually fused into a single, compound sclerite (fig. 5); parasternal areas carrying the legs; poststernellar area without sclerite and setae.

Mesothoracic and metathoracic segments (text fig. 2) dorsally divided by a transverse median, at the ends anteriorly curved, sulcus into the prescutal area (*pse*) and the scuto-scutellar area (*sc-scl*); both areas carrying on each side an interior larger sclerite (*int*) and

<sup>4</sup> Possibly corresponding to the spiracular areas of the following thoracic segments.

an exterior smaller one (*ext*). The alar area (*al*) and the spiracular area (*spi*) combined into a parascutal region (*pasc*) above limited by an indistinct sulcus marked and produced by a few dorso-ventral muscles (†) to the coxal region (“the noto-coxal muscles”) and below by the oblique dorso-lateral sulcus (*dl*). Parascutal region carrying two sclerites, a minor anterior (*ant*) or spiracular sclerite in the spiracular area and a large posterior (*post*) or alar sclerite in the alar area. Interior prescutal as well as the interior scuto-scutellar sclerites arranged closely together (fig. 18) or only separated in the sagittal line by a continuation of the sagittal suture of the prothoracic shield (figs. 21 to 24). In *Monocesta coryli* (fig. 1), all tergal sclerites absent except the interior prescutal and interior scuto-scutellar; in *Monoxia consputa* (fig. 9) no sclerite developed; in *Galerucella nymphaeae* (fig. 18) and *Galerucella lineola* interior and exterior prescutal sclerites fused into a single compound sclerite

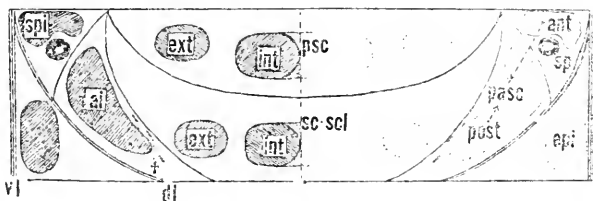


FIG. 2.—DIAGRAM OF MESOTHORACIC AND METATHORACIC SEGMENTS. FOR LETTERING SEE TEXT

just as the interior and exterior scuto-scutellar sclerites. The epipleural area (*epi*) triangular, limited above by the oblique dorso-lateral sulcus (*dl*) and below by the straight ventro-lateral sulcus (*vl*), carrying one sclerite. Hypopleural sclerites (episternum and epimeron) as in prothorax. The presternal, the eusternal, and the sternellar (combined with the coxa bearing parasternal) areas well limited by sulci but often with indistinct sclerites. Poststernellar area present in mesothorax, absent in metathorax. (Fig. 5.) Mesothoracic and metathoracic sclerites usually with a few or moderate number of short or medium long setae.

The typical abdominal segments (text fig. 3) differ from the mesothoracic and metathoracic segments mainly by having the dorso-lateral sulcus running parallel with the ventro-lateral sulcus and not obliquely toward it. The parascutal region of the thorax with the distinct alar and spiracular areas becoming smaller in the abdomen and practically fused into a single area, the parascutal area (*pasc*) of the abdomen; the epipleural area (*epi*) becoming larger and changing form from triangular in the thorax to rectangular in the abdomen. Otherwise the arrangement of the areas and the number of the sclerites in the areas are as in the mesothorax and metathorax.

First to eighth abdominal segments: In most genera (figs. 4, 10) dorsally divided by one transverse sulcus into a prescutal and a combined scuto-scutellar area, more rarely, in *Agelastica alni* (fig. 15) and *Sermylassa halensis* (fig. 14), divided by two transverse sulci into a prescutal, a distinct scutal, and a distinct scutellar area. The prescutal area and the scuto-scutellar area (in *Agelastica* and *Sermylassa*, the scutellar area) each carrying on both sides an interior (*int*) and an exterior (*ext*) sclerite. The scutal area, when distinct, carrying either a small (*Agelastica*) or a well-developed sclerite (*Sermylassa*). The interior prescutal sclerite and the interior scuto-scutellar sclerite usually fused in the sagittal line with the corresponding sclerites of the opposite side; the exterior scuto-scutellar sclerite nearer the sagittal line than the exterior prescutal sclerite. The parascutal area (*pasc*) marked above by a few longitudinally placed impressions of muscles corresponding to the noto-coxal muscles of thorax (†) and

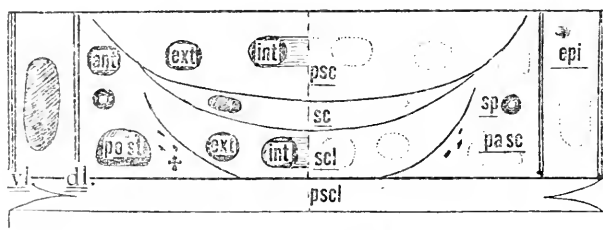


FIG. 3.—DIAGRAM OF TYPICAL ABDOMINAL SEGMENTS. FOR LETTERING SEE TEXT

below limited by the dorso-lateral sulcus (*dl*); the area never extending down to the ventro-lateral sulcus as in thorax. The parascutal area normally carrying two sclerites, one anterior to the spiracle, the anterior parascutal sclerite (*ant*), and one posterior to the spiracle, the posterior parascutal sclerite (*post*). Spiracle in most of the larvae placed directly in the soft skin, but sometimes lodged in a special sclerite, the spiracular sclerite (figs. 4, 11, 14), and sometimes located in the anterior parascutal sclerite (fig. 18). The anterior and the posterior parascutal sclerites fused in a few larvae (fig. 3), the anterior sclerite absent in many larvae (figs. 7, 24) and exceptionally (figs. 1, 9) the anterior and posterior sclerites both undeveloped. The epipleural area (*epi*) subrectangular, carrying one well-developed sclerite. The hypopleural area (fig. 7) situated directly below the ventro-lateral sulcus, carrying one well-developed sclerite. The sternal region (fig. 5) with an unpaired eusternal area and a paired area probably formed by fusion of the parasternal and sternellar areas; the presternal area absent; the poststernellar area absent in some genera (fig. 6), present in others (fig. 5), and in some of the latter genera (fig. 15, *Agelastica*) developed as an intersegmental

band. The eusternal and each of the sternellar areas usually with a thinly chitinized, lightly colored, and indistinctly limited sclerite.

Ninth abdominal segment (figs. 3, 14) either moderately large or rather small, in dorsal view subrectangular to semilunar, covered by a pygidial shield; ventral parts of the segment forming a small, narrow band often covered by a thin chitinous plate; areas not differentiated; a series of a few setae present.

Tenth abdominal segment (fig. 60) developed as a large, retractile, powerful pygopod with the sucking surface marginally lobed and anal opening placed in the middle of the surface.

Legs (fig. 62) inserted widely apart, strongly chitinized, at least on the exterior side, of moderate length, about as long as half the width of a thoracic segment, usually darkly colored, five-jointed. Coxa sessile, with a large, soft, whitish area for the reception of trochanter and femur; trochanter well developed, as long as coxa, subtriangular, in contact with almost the entire underside of femur; femur corresponding in form and size to trochanter; tibia subcylindrical, about as long as the combined femur and trochanter and also as long as coxa; claw usually strongly curved, enlarged at base and terminally pointed, rather short. Paronychial appendix (*po*) fleshy, whitish, projecting behind the claw from a soft skinned area at the end of tibia.

Spiracles (fig. 58) annuliform, all lateral and of equal, moderate size; one located in mesothorax, one rudimentary in metathorax and one in each of the first eight abdominal segments. The inside of the spiracular mouthpiece beset with numerous minute spinulæ; no definite atrium. (Fig. 57.) The closing apparatus of the one-armed type, located close to the spiracle proper.

Defensive glands (fig. 15) present only in a single larva, *Agelastica alni*, and here aggregated in the wall of sacs that can be turned inside out and that are located above the spiracles and between the almost fused anterior and posterior parascutal sclerites of the first to eighth abdominal segments.

*Habits.*—The larvae of the Galerucinae are herbivorous and external feeders, except the larva of *Monoxia consputa*, which mines inside the leaves of *Chenopodium album* and some related plants. The larvae are usually found on the same host plants as their imagines but make feeding marks of a different type; they never cover themselves with their excrements, and, with the exception of the larva of *Agelastica alni* mentioned above, have no defensive organs. After a larval period represented by three instars the pupation takes place either in the soil inside of a cell-shaped excavation whose walls may or may not be reenforced by spun threads (*Monocesta coryli*, the species of *Trirhabda*, *Galerucella cavicollis*, *G. kalmiae*, *G. vaccinii*,

*G. spiraeae*, *G. alni*, *G. decora*, *G. perplexa*, probably *G. viburni*, *Monoxia puncticollis*, *Lochmaea capraea*, all the species of *Galeruca*, *Sermylassa halensis* and *Agelastica alni*) or the pupation takes place above the soil. In some of the species whose larvae pupate above the soil the pupa is rather unprotected and found loose on the ground, in small crevices, under pieces of wood, etc. (*Galerucella luteola*) or it is attached to a leaf by the end of the abdomen (*Galerucella nymphaeae*, *G. lineola*), or the pupa is encased in a cocoon with a reticulate wall fastened to a leaf (*Galerucella notata*, *Galerucella cribrata*).

*Literature.*—The latest list of literature concerning Galerucinae larvae is found in a Danish book entitled "Victor Hansen: Biller (Chrysomelidae og Lariidae) 1927." The list is given on pages 390–395, at the end of a chapter, written by K. L. Henriksen, on the larvae of the Danish Chrysomelidae and Lariidae. The publication is No. 31 of a series of faunistic manuals, called Danmarks Fauna, which are edited by the Danish Society of Natural History and published by G. E. C. Gad, Copenhagen, Denmark. References to Henriksen's descriptions in this manual will in the following pages be given as "1927, Henriksen, K. L., Danmarks Fauna No. 31."

Another publication with many bibliographical notes and important descriptions to which reference often will be made is by William Colcord Woods. It constitutes Part 2 of Bulletin 319, from Maine Agricultural Experiment Station, Orono, University of Maine, 1924, and deals with the blueberry leaf beetle and some of its relatives. It will be referred to in the following as "1924, Woods, W. C., Maine Agr. Exp. Sta. Bull. 319."

#### KEY TO GENERA AND SPECIES<sup>5</sup> CONSIDERED

1. Typical abdominal segments with three transverse dorsal areas, distinct scutal area present. With or without supra-spiracular glands..... 13.  
 Typical abdominal segments with two transverse dorsal areas, distinct scutal area absent. Supra-spiracular glands never developed..... 2.
2. Head capsule with a posterior emargination about as deep as the length of the coronal (median epicranial) suture. Abdominal segments with very thin, almost invisible sclerites. **Monoxia consputa** LeConte (p. 28, fig. 9).  
 Head capsule posteriorly rounded, without or with slight emargination. Abdominal segments with at least one distinct sclerite and usually with more than one..... 3.
3. Prescutal area of abdominal segments without any sclerite. (Scuto-scutellar area with a single, median, rather small and rounded sclerite). Third tooth of mandible comb shaped, with serrated inner margin.  
**Monocesta (M. coryli)** Say, p. 10, fig. 1).
- Prescutal area of abdominal segments with sclerites. Third tooth of mandible subtriangular, claw shaped..... 4.

<sup>5</sup> Refers to the full-grown larvae (3d instar) when not otherwise indicated.

4. Most sclerites on the upper surface of the body prolonged into senti<sup>6</sup>----- 11.  
Sclerites not developed as senti----- 5.
5. Abdominal spiracles lodged in a large sclerite----- 6.  
Abdominal spiracles either free or bordered by a narrow ring----- 7.
6. Abdominal dorsal sclerites of moderate size, their setae distinct. Scuto-scutellum with interior and exterior sclerites separate. Mandible without penicillus. Maxillary palpus with four joints as normal in Galerucinae.

*Trirhabda* (*T. canadensis* Kirby, p. 12, fig. 3; *T. virgata* LeConte, p. 14; *T. brevicollis* LeConte, p. 15; *T. nitidicollis* LeConte, p. 15; *T. tomentosa* Linnaeus, p. 15; *T. attenuata* Say, p. 15).

Abdominal dorsal sclerites large, covering the back almost completely, setae minute or absent. Scuto-scutellum with interior and exterior sclerites fused. Mandible with penicillus. Maxillary palpus three-jointed.

*Galerucella*, Group A (*G. nymphaeae* Linnaeus, p. 16, fig. 18; *G. lineola* Fabricius, from Europe, p. 18; *G. sagittariae* Gyllenhal, from Europe, p. 18).

7. Parasental area of abdominal segments with anterior sclerite developed-- 8  
Parasental area without the anterior sclerite----- 10.
8. Several setae present on most of the dorsal sclerites of the abdomen (body with longitudinal black and yellow bands alternating)----- *Galerucella*, Group B (*G. luteola* Müller, p. 19, figs. 4, 21; *G. species*, p. 21).  
Not more than two (exceptionally three) setae on any single dorsal sclerite or on each side of any compound median sclerite----- 9.
9. Scuto-scutellum of abdomen with exterior sclerite distinct---- *Galerucella*, Group C. (*G. viburni* Paykull, European species, p. 21, fig. 23).  
Scuto-scutellum of abdomen with exterior and interior sclerites fused into a single median compound sclerite----- *Galerucella*, Group D. (*G. cavicollis* LeConte; *G. kalmiae* Fall; *G. decora* Say; *G. perplexa* Fall; *G. vaccinii* Fall; *G. spiraeae* Fall, fig. 22; *G. alni* Fall.)<sup>7</sup>
10. Dorsal sclerites of abdomen carrying a number of setae varying from one or two on some sclerites, to three or four on others. (Mandible with five teeth and inner margin behind the teeth blade shaped and obtusely rounded anteriorly)----- *Galerucella*, Group E. (*G. notata* Fabricius, p. 23, figs. 24, 29; *G. cribrata* LeConte, p. 26); and *Monoxia puncticollis* (Say) (p. 26, figs. 7, 50).<sup>8</sup>
- Dorsal sclerites of abdomen on each side with one long seta on each sclerite----- *Lochnaea* (*L. capreae* Linnaeus, first stage larva, from Europe, p. 29, fig. 6).

<sup>6</sup>"Sentus" has recently been defined as a more or less slender, unbranched chitinous process of the body, from which well-developed setae radiate.

<sup>7</sup>The species here listed as having larvae belonging to "*Galerucella* type D" are treated in the very valuable paper, *The Blueberry Leaf Beetle and Some of Its Relatives*, by H. C. Fall and W. C. Woods (Maine Agric. Exp. Sta., Orono, Bull. 319, 1924). Doctor Woods has given descriptions and diagrams of the arrangement and form of the sclerites and the distribution of the setae in the larvae of all the species mentioned of group D, *Galerucella cavicollis* excepted, but according to Mr. Fall's remarks (p. 87) that *Galerucella kalmiae* is "extremely similar to *cavicollis*, from which \* \* \* it is scarcely distinguishable," one may expect to find the sclerites and setae of the *cavicollis* larvae arranged as shown in Doctor Wood's diagram of the *kalmiae* larva. No larva of *G. cavicollis* is preserved in the National Museum.

<sup>8</sup>The larva of *Monoxia puncticollis* does not represent a distinct generic type. It belongs to the *Galerucella* group E, and is separated from the two species of this type mainly by the smaller size of its setae (figs. 30 and 47) and dark colored skin with light sclerites, whereas the two *Galerucella* species normally are light colored with large, dark setal cups.

11. Abdominal segments with exterior prescutal sclerite small, about twice, or less than twice, the size of one of the spiracles, and located as far from the interior prescutal sclerite as four or five times its own diameter, or even farther. (Setae of moderate size and brownish.)

*Galeruca pomonae* Scopoli (p. 34, fig. 12).

Exterior prescutal sclerite three times or more the size of one of the spiracles, and located as far from the interior prescutal sclerite as from two to three times its own diameter, or even nearer..... 12

12. Senti generally slender and as long or longer than their diameter at base. Interior prescutal sclerites of the posterior abdominal segments not fused in the middle line. Setae long and creamy white.

*Galeruca tanacetii* Linnaeus (European species, p. 31, fig. 13a).

Senti generally plump and shorter than their diameter at base. Interior prescutal sclerites of the posterior abdominal segments fused in the middle line. Setae moderately long and brownish— *Galeruca laticollis* Sahlberg (European species, p. 34, fig. 11a).

13. Abdominal segments with a transversely elongate scutal sclerite. No supra-spiracular glands— *Sermylassa halensis* Linnaeus (p. 35, fig. 14).

Abdominal segments with a small round scutal sclerite. A large supra-spiracular gland lodged between the nearly contiguous anterior and posterior parascutal sclerites— *Agelastica alni* Linnaeus (p. 38, fig. 15).

## DESCRIPTIONS AND NOTES

### MONOCESTA CORYLI (Say)

(U. S. Nat. Mus.; described from larva in vial marked "St. Thomas, Pennsylvania, July 20, 1921; E. M. Craighead, Coll.). Reared.

*Mature larva* (figs. 1, 2).—About 15 mm. long.

Head brown and somewhat shining, epicranial suture a black median line. Body dorsally dull brown and leathery with the chitinizations of about the same color, though slightly more yellowish and shining; underside of body yellowish brown; legs brown and shining, light colored on the inner side.<sup>9</sup>

Setae short to moderately long and pointed on the head, the prothoracic and pygidial shields, the laterally projecting lobes of the body and the legs; rest of body without setae or with minute setulae here and there.

*Head capsule* (fig. 34).—With a large, rather flat median depression in the frons behind the epistomal margin; a few deep striations radiating from the middle of the depression.

*Labrum* (fig. 35).—Subtriangular, about as long as wide, with lateral margins somewhat incurved anteriorly; distal end slightly emarginate. Discal setae not fully as long as labrum; marginal setae inserted in the incurved part of labrum, five present on each side, almost half as long as the discal setae.

*Mandible* (figs. 45, 48).—Ruffled from base to near the middle, especially on the exterior side. Four teeth present, inner margin of

<sup>9</sup> Larva in first stage glossy yellow; with each shedding of the skin becoming more brownish.



mandible immediately behind the teeth projecting into an obtuse low process; third tooth much larger than the rest, subrectangular and with multiserrated edge. Penicillus absent; two setae present on exterior side of mandible.

*Maxilla* (figs. 56, 59, 61, 63).—Lacinia soft, densely setose, and with half a dozen long, spine-shaped setae; galea smoothly chitinized, having about the same number of similarly shaped setae as lacinia and a short, pointed cone-shaped appendix between them.

*Postlabial band* (fig. 63*b*).—Semicircularly curved.

*Prothorax* (figs. 1, 2).—Shield with a finely aciculate surface and on each side a large, irregularly variolose depression; in the sagittal line a sharp furrow and at the end of this a small triangular deepening; margin thick and rounded, carrying a few short and thin setae. Epipleural area with a small, round, slightly chitinized projection carrying a few soft, short hairs. Prehypopleurum (=episternum) with a yellowish sclerite and a few soft setae. Posthypopleurum (=epimeron) with no distinct sclerite; a few soft setae present. Jugular region membranous. Eusternal plate median, large, transverse, crescent shaped, and with a single row of several setae. Each sternellar plate round, with a single seta.

*Mesothorax and metathorax* (figs. 1, 2).—Prescutal and scuto-scutellar areas separated by a deep transverse furrow. Prescutum of mesothorax with a small, but distinct sclerite on each side close to the sagittal line. Prescutum of metathorax without distinct sclerites. Scuto-scutellum both of mesothorax and metathorax carrying a small sclerite on each side close to the sagittal line. Alar area flat, freely projecting over epipleural area below, and carrying on an irregularly bilobate sclerite several fine setae. Spiracular area with a single seta. Epipleural area bearing a small, rounded, shining, setose projection. Prehypopleural and posthypopleural areas as in prothorax. Eusternal and sternellar sclerites weak.

*First to eighth abdominal segments* (figs. 1, 2).—Prescutal area separated from scuto-scutellar area by a deep transverse groove; prescutal area without any sclerite. Scuto-scutellar area with an unpaired median, rather small and scale-like sclerite. Parascutal area not sharply defined and without sclerites. Epipleural lobe projecting, cone-shaped, and provided with a chitinous top with a few short setae. Hypopleural area soft, with two moderately long setae. Eusternum soft with a single seta on each side. Sternellum (plus parasternum) soft, with two setae.

*Ninth abdominal segment* (figs. 1, 2).—Pygidial shield subrectangular, transverse with broadly rounded corners, leatherlike with discal part more glossy; about a dozen moderately long setae located in the hind margin in a single irregular row. Ventral part of segment with about half a dozen setae on each side.

*Tenth abdominal segment* (fig. 60).—With six pear-shaped lobes radiating from anus in the middle of the sucking surface. Each side with a slightly chitinized and setae bearing plate.

*Leg* (fig. 62).—Coxa, trochanter, femur, and tibia brown with distal end blackish, claw blackish brown. Tibia rather short, somewhat contracted and bent medianly.

*Habits*.—Feeding on the leaves especially of red elm, also recorded from hazel (*Corylus americanus*), skeletonizing one leaf after another; feeding when in first and second stages on the underside but in the third stage indiscriminately on either side, usually refusing to touch the epidermis of the opposite side but sometimes eating holes through the leaves. Pupates in the ground in a simple oval cavity, a few inches below the surface.

*Literature*.—

RILEY, C. V.

1879. "Report of Commissioner of Agriculture for the year 1878," pp. 245-277, pl. 4, figs. *a-h* (Reprint in "Author's Edition" from Annual Report of Dept. of Agr. 1878. Charles V. Riley, August 1879, pp. 40-42).

HOWARD, L. O.

1905. U. S. Dept. Agr.; Bull. 54, pp. 81-82.

**TRIRHABDA CANADENSIS Kirby**

(U. S. Nat. Mus.; described from larva in vial marked "North East, Pennsylvania, 1919. E. M. Craighead coll." Reared.

*Mature larva* (fig. 3).—About 12 mm. long.

Head (fig. 37) smooth, varying in color from brownish, in some specimens brownish with black specks, to deep bluish black; labrum shining black; anterior corners of frons light, frontal sutures whitish, sagittal line above carina of frons black. Body varying in color from dull brown to indigo-blue; prothoracic shield uniformly iridescent dark with light median suture; pygidial shield and dorsal and lateral sclerites transversely striate, with indistinct margins gradually blending into the similarly colored, dark and iridescent skin; underside of body cream colored with thin but distinctly colored ochreous sclerites. Legs usually blackish brown with ochreous inner side.<sup>10</sup>

Setae whitish, thin, pointed, easily broken, about half, or less, as long as the length of a body segment, present in moderate numbers.

*Head capsule* (fig. 37).—On each side close to the epistomal margin and near to the sagittal line with an irregular depressed area bearing two setae.

*Labrum*.—Subrectangular, about twice as wide as long, with front margin slightly emarginate medianly. Discal setae thin, not fully as long as labrum; marginal setae short and fine.

<sup>10</sup>Larva in first stage uniformly brownish, rather glossy, with setae somewhat longer than each body segment.

*Mandible* (fig. 49).—With five teeth; first tooth small, narrow, easily overlooked, second and third (the larger) both pointed and claw shaped, fourth and fifth small and fused at bases. Penicillus absent; two short setae externally.

*Maxilla* (fig. 66).—Lacinia at base shining, distally membranous, covered with fine, short hairs, and carrying a few stiff setae; galea smoothly chitinized, armed with half a dozen spinelike setae and between these a small cone-shaped appendix.

*Postlabial band* (fig. 66).—Slightly curved forward medianly, laterally strongly rounded.

*Prothorax* (fig. 3).—Thoracic shield at the anterior and posterior ends of the sagittal suture with an unpaired, minor, triangular deepening, and on each side in the middle of the disk a large, rounded depression irregularly pitted at the bottom. Moderately long and rather numerous setae inserted anteriorly and posteriorly in the margin. Epipleural area with a rather large, dark-colored sclerite, in character similar to the alar sclerite of the posterior thoracic segments. Prehypopleural and posthypopleural sclerites (=episternum and epimeron) oval, similar in size and color. Eusternal and sternellar sclerites almost fused into one subquadrate plate, with four setae on each side.

*Mesothorax and metathorax* (fig. 3).—The compound interior pre-cutal sclerite with a fine white sagittal suture, on each side with two primary and a few secondary setae; exterior pre-cutal sclerite considerably smaller than each interior one, one primary seta and a few minute secondary ones. Interior compound scuto-scutellar sclerite similar to the interior pre-cutal sclerite and carrying the same number of setae; exterior scuto-scutellar sclerite large, round, with three primary setae. Alar area thick, somewhat projecting laterally, carrying a large, simple, rounded sclerite with four primary setae and several small secondary ones. Spiracular area with a small sclerite around the spiracle and one primary seta. Epipleural area with a sclerite carrying two or three setae. Pre- and posthypopleural sclerites as in prothorax. Eusternal sclerite large, oval, distinctly outlined and with about four setae on each side. Sternellar sclerite paired, small and not so distinctly outlined, with one seta.

*First to seventh abdominal segments* (fig. 3).—The compound, interior pre-cutal sclerite large, rather long and broad, with two primary setae on each side; exterior pre-cutal sclerite rounded and well separated from the interior sclerite, with one or two setae. Compound interior scuto-scutellar sclerite not so broad, but otherwise very similar to the pre-cutal, one or two primary setae present; exterior scuto-scutellar sclerite located closer to the middle line than

exterior prescutal sclerite, otherwise very similar to this, one or two setae. Anterior and posterior sclerites of the parascutal area fused to a single round, rather large compound sclerite in which the spiracle is lodged, two primary setae posteriorly and a few secondary around the spiracle. Epipleural lobe cone shaped, with a sclerite carrying three or four primary setae on the top and as many secondary ones. Hypopleural sclerite distinct, well chitinized and well colored, two setae. Compound eusternal sclerite distinctly outlined, color rather dark and sharply contrasting against the light-colored skin of the ventral side of the body, one or two primary setae on each side. Sternellar area (plus a parasternal or "coxal" lobe, particularly distinct in the present larva) with two small sclerites; the outer one circular in outline with two setae, the inner one a mere chitinous grain with one seta; both sclerites rather dark and standing out sharply against the light ventral skin.

*Eighth abdominal segment.*—With interior and exterior scuto-scutellar sclerites fused into a single compound plate with three setae on each side; otherwise not differing much from the preceding segments except in size.

*Ninth abdominal segment.*—Pygidial shield subrectangular with rounded corners, a thick margin, and a somewhat elevated corrugated discal part; several moderately long and some short setae in the margin and a few on the disk.

*Tenth abdominal segment.*—With six large, almost equally sized pear-shaped lobes radiating from anus.

*Habits.*—Eating foliage of *Solidago*; has been recorded as defoliating *Artemisia* sp in Arizona. Pupates in the ground.

*Literature.*—

BALDUF, W. V.

1929. Ent. News, vol. 40, p. 35. (Life History and Bibliography.)

#### TRIRHABDA VIRGATA LeConte

(U. S. Nat. Mus.; described from larva in vial marked: "On *Solidago*. Camp Hill, Pennsylvania, F. M. Trimble coll.") Not recorded as reared.

No characters have been found by which the larva of this species can be definitely separated from the larva of *T. canadensis*.

In both species the larvae appear to vary somewhat in regard to color, the length and number of the setae, and the distance between the interior and exterior sclerites of prescutum and scuto-scutellum. As, however, the imagines are closely related, occur in the same localities, and feed together with their larvae on the leaves of the same food plant, the probability is that the larval material of both species is mixed in our collections.

**TRIRHABDA BREVICOLLIS** LeConte

(U. S. Nat. Mus.; described from larva in vial marked: "F. H. Chittenden June 1901, Victoria, Texas, J. D. Mitchell coll.") Probably reared.

Mature larvae differs from that of *T. canadensis* in having light brownish skin and small dark-brown dorsal sclerites. Each abdominal segment with exterior sclerites of prescutum of about the same size as a spiracle and distance between exterior and interior sclerites of scuto-scutellum about three times the diameter of the exterior sclerites. Sternal sclerites of abdomen very thin and of the same pale yellow color as the skin; sternal region of abdomen therefore apparently without sclerites.

*Habits.*—Larva of *T. brevicollis* defoliates the bushlike tree of *Zanthoxylum* (Rutaceae) or prickly ash.

According to L. O. Howard,<sup>11</sup> J. D. Mitchell, Victoria, Tex., says "the larvae burrow into the ground, where it is slightly raised, making runs or galleries from which they crawl out or about day and night, but never more than a few inches from the colony home." The pupal stage is passed in the ground.

**TRIRHABDA NITIDICOLLIS** LeConte

(U. S. Nat. Mus.; described from larva in vial marked: "No. 4979, Los Angeles, California, D. M. Coquillett coll.") No record of rearing.

The mature larva resembles the larva of *T. canadensis* by having dorsal sclerites of about the same size and similarly striated as in that species and by having rather long setae. It differs from it by being somewhat lighter in color with greenish, bronze-colored dorsal skin and sclerites and by having pale-yellow ventral skin and very thin and pale-yellow sternal sclerites on the abdomen.

**TRIRHABDA TOMENTOSA** Linnaeus

(U. S. Nat. Mus.; described from larva in vial marked: "708, Haw Cr. Florida, 1896.") H. G. Hubbard collected and determined, probably by rearing.

Resembles the larva of *T. canadensis* in most characters, but has slightly larger dorsal sclerites and much thinner and shorter setae, the latter being about half as long as the sclerites in which they are inserted.

**TRIRHABDA ATTENUATA** Say

(U. S. Nat. Mus.; vial marked: "Hopk. U. S. 15729a. On foliage of *Artemisia* species. Yosemite Park, California, July 24 1918. T. E. Patterson.") Reared.

The mature larva is somewhat smaller, more elongate and cylindrical than *T. canadensis*. The color is dark bronze dorsally and

<sup>11</sup> U. S. Dept. Agri. Bull. No. 38, new series, 1904, p. 108.

dark ochreous ventrally; dorsal and ventral sclerites well defined. Setae long, strong, and many of the dorsal ones slightly enlarged at the end, a development not noticed in the other investigated *Trivhabda* larvae, in all of which the setae are pointed.

GALERUCELLA NYMPHAEAE Linnaeus

(U. S. Nat. Mus.; described from larva in vial marked: "Craighead, Pennsylvania, July 4, 1921, E. M. Craighead Coll.") Reared.

*Mature larva* (fig. 18).—About 10 mm. long.

Head smooth and shining, either entirely black or with reddish-brown anterior margin; labrum cream colored with dark posterior corners; coronal (=median epicranial) and frontal sutures appearing as fine white lines. Body with membranous parts greenish-gray; prothoracic shield, dorsal sclerites and pygidial shield shining, dark chestnut brown; all three thoracic segments with a whitish sagittal suture; dorsal sclerites coarsely corrugated and covering almost the entire upper side of the body, skin between the sclerites appearing only as light lines; pygidial shield variolose, irregularly and coarsely corrugated and uniformly colored; underside of body light greenish-gray with sclerites small and light ochreous. Legs blackish brown on the exterior side, ochreous on the inner side.

Setae short, thin, and pointed (fig. 17); most sclerites with few minute spinulae.

*Head capsule*.—With an unpaired shallow anterior depression behind epistomal margin; a small grain-shaped elevation on each side in the posterior corner of frons.

*Labrum* (fig. 16).—About twice as wide as long; anterior margin forming an arch of about 120°. Discal setae rather short, straight, and pointed; marginal setae short, curved, and pointed.

*Mandible* (fig. 19).—With five teeth; inner margin behind the last tooth somewhat incurved; first tooth small and narrow, second, third, and fourth larger, all pointed and claw shaped; fourth and fifth completely separated; fifth short and broad, penicillus present; two short setae located externally.

*Maxilla* (fig. 20).—With lacinia distally pectinate, carrying a row of about 10 subcylindrical, distally obtuse, strong, and long setae, all of same length and build; galea armed with six spinelike setae of moderate length, between these a short, cone-shaped tactile appendix; maxillary palpus with only three joints, basal joint (often referred to in the literature as "palpiger") characterized by two long setae; the virtual palpiger soft, light colored, without individual muscles, and located distally to the chitinized stipes.

*Postlabial band*.—Medianly somewhat forward curved, laterally strongly rounded.

*Prothorax* (fig. 18).—Prothoracic shield with a somewhat cordiform depression anteriorly in the sagittal line and six to eight foveae on each side between the sagittal middle line and the margin of the shield; anterior and posterior margin with a few minute setae. Epipleural area with a large sclerite. Prehypopleural and posthypopleural sclerites (= episternum and epimeron) oval, about similar in size and color. Eusternal and sternellar sclerites fused into a single, rectangular, median plate; with two minute setae on each side.

*Mesothorax and metathorax* (fig. 18).—Interior and exterior sclerites of prescutum fused to a single compound plate with a sagittal white line and a curved, white, incomplete line indicating the limit between the exterior and interior sclerites. Interior and exterior sclerites of scuto-scutellum developed as in prescutum. Alar area carrying a large sclerite, as long as the entire segment and anteriorly separated only by a fine suture from a sclerite covering the entire spiracular area; both areas with a few minute setulae. Epipleural area with a large subtriangular sclerite with a few setulae. Prehypopleural and posthypopleural sclerites as in prothorax. Eusternal sclerite median, single, approximately crescent shaped, three times as broad as long, densely asperate, and with two setae on each side. Sternellar sclerite paired, developed as a minute asperate disk around the foot of a small seta.

*First to eighth abdominal segments* (fig. 18).—Compound interior sclerite of prescutum separated from exterior sclerite by a thin white suture. Compound interior sclerite of scuto-scutellum fused with exterior sclerite on each side into one single scuto-scutellar plate. Anterior and posterior sclerites of the parascutal area about equal in size, and separated by an oblique furrow; spiracle situated in the anterior sclerite. Epipleural sclerite about as long as the segment and subquadrate. Hypopleural sclerite distinct, ovate, with two small setae. Compound eusternal sclerite asperate and of the same form and size as in mesothorax and metathorax. Sternellar area with one small, round, and darkly colored asperate sclerite on each side, and in some of the segments with a dark speck close to the middle line; one or two small setae on the sclerite, one on the minute speck.<sup>12</sup>

*Ninth abdominal segment*.—Pygidial shield subrectangular with rounded corners, leathery, variolose, and with about half a dozen

<sup>12</sup> The sternellar sclerites may be reduced in size in some of the abdominal segments while they are distinct in the other segments of the same larva, but specimens in which sternellar sclerites are completely absent are not found in the material of larvae of *G. nymphaeae* preserved in the National Museum. K. L. Henriksen, however (see bibliography), finds that these sclerites are regularly absent in the European specimens of the same species.

moderately long setae in the margin. Ventral part of ninth segment transverse, carrying band-shaped sclerite with two setae on each side.

*Tenth abdominal segment.*—With four anal lobes, the lateral one on each side large and round.

*Habits.*—Nibbling on the upper surface of floating leaves of water lilies and many species of *Polygonum*, leaving the epidermis intact on the under side. Larva fastens itself by its tail end to the leaf before transforming into pupa; last abdominal segments of pupa covered by larval skin. According to J. P. Kryger<sup>13</sup> also found on *Mentha*, from which plant it was reared.

*Literature.*—

MACGILLIVRAY, A. D.

1903. New York State Museum, Bull. 68, pp. 325–326, pl. 27, figs. 8 and 9 [both incorrect] and pl. 31.

CHITTENDEN, F. H.

1905. U. S. Dept. of Agri., Bur. Ent. Bull. n. s., No. 54, pp. 59–60. (“So abundant in the District of Columbia that the imagines deserted the natural aquatic food plants, as *Nymphaea*, *Sagittaria*, *Brasenia*, and *Nuphar*, and attacked near-by plants of other families, such as basket willow and beans, doing considerable damage.”)

WOODS, W. C.

1924. Maine Agr. Exp. Sta. Bull. 319, p. 134.

HENRIKSEN, K. L.

1927. Danmarks Fauna No. 31, p. 348.

**GALERUCELLA LINEOLA Fabricius**

(U. S. Nat. Mus.; described from larva in vial marked: “On *Rumex* sp. Seeland, Denmark, E. A. Rosenberg collected, reared, and dedit.”) Reared.

No characters have been found by which the larva of this species can be definitely separated from the larva of *G. nymphaeae*. It pupates also above the ground attached to a leaf, and with the end of the abdomen covered by the skin of the last larval instar (seen on material in the U. S. National Museum).

K. L. Henriksen records as food plants of *G. lineola* only *Salix* and *Alnus*, whose leaves it skeletonizes, but E. A. Rosenberg has added *Rumex* species. Chittenden mentions (see literature on *G. nymphaea*) that adults of the species of *G. nymphaea* occasionally feed on salix.

**GALERUCELLA SAGITTARIAE Gyllenhal (=G. GRISESCENS Joannis)**

(U. S. Nat. Mus.; larva described from vial marked: “On the leaves of *Potamogeton* species, Doune, Denmark, 26 July 1925; imago developed 3 August 1925. E. A. Rosenberg leg. et ded.”) Reared.

The larva of this species can not be distinguished from that of *G. nymphaeae*.

<sup>13</sup> Entom. Medd. Copenhagen, vol. 13, 1919, p. 38.



*Literature.*—

CHITTENDEN, F. H.

1905. U. S. Dept. of Agri., Bur. Ent. Bul. n. ser., No. 54, pp. 58.

HANSEN, VICTOR.

1927. Danmarks Fauna No. 31, p. 154 (as food plants are mentioned *Lysimachia vulgaris* and *L. thyrsoiflora* and "possibly other water plants").

## GALERUCELLA LUTEOLA Muller (= G. XANTHOMELAENA Schrank)

(U. S. Nat. Mus.; described from larva in vial marked: "On elm, July 21, 1907. Roselle, N. J.—B. H. Jouett, coll.") Reared.

*Mature larva* (figs. 4, 5).—About 12 mm. long.

Head shining black with black labrum; frontal sutures fine whitish lines; body somewhat varying in color, generally dull yellow, with a pair of longitudinal black stripes along the back meeting near the end of the abdomen; prothoracic shield yellow with a large black spot on each side; pygidial shield shining, black; underside of body yellowish with blackish sclerites; legs reddish brown to black, lighter on the inner side.<sup>14</sup>

Setae moderately long and moderately strong, pointed and yellowish; present in considerable number on the back and the sides of the larva.

*Head capsule* (fig. 38).—With a large unpaired depression in the middle of frons posterior to epistomal margin.

*Labrum*.—Subrectangular, about twice as wide as long, with front margin slightly emarginate medianly. Discal setae somewhat longer than labrum itself; marginal setae short and fine.

*Mandible* (fig. 46).—With four teeth, the second of which being the larger and more extended; inner margin of mandible immediately behind the third tooth projecting into an obtuse process, here considered as the fourth tooth. Penicillus present; no setae found on exterior face of mandible.

*Maxilla* (fig. 67).—With lacinia carrying a few stiff setae; galea having about seven similar setae and a rather short cone-shaped appendix between them.

*Postlabial band* (fig. 5).—Semicircular.

*Prothorax* (figs. 4, 5, 21).—Shield with a small subtriangular deepening in front of and a similar one at the end of a whitish median suture, on each side a large, darkly colored depression. Numerous setae inserted in a double row along the whole margin and a few found inside of these. Epipleural area with a large yellow sclerite carrying six setae. Prehypopleural sclerite (= episternum) light colored with about four setae; posthypopleural sclerite (= epimeron)

<sup>14</sup>Newly hatched larvae nearly black; with each shedding of the skin the yellow color becomes more dominating.

also light colored with about four setae. Ventrally with a dark subtriangular eusternal sclerite wedged in between and almost fused with a pair of dark, rounded and small sternellar sclerites, the compound plate carrying two primary setae on each side.

*Mesothorax and metathorax* (figs. 4, 5, 21).—Interior prescutal sclerite almost completely fused with the interior sclerite of the opposite side, the sagittal suture only indicated at each end of the compound plate, light colored, six setae; exterior prescutal sclerite distinct, dark colored, about five setae. The interior scuto-scutellar sclerite similar to interior prescutal sclerite but somewhat smaller, light colored, on each side armed with about four setae; exterior scuto-scutellar sclerite large, round, dark colored, with about eight setae. Alar sclerite large, dark, with about 12 setae. Spiracular area somewhat chitinized and armed with a single seta. Epipleural area triangular, with a moderately large, light colored sclerite carrying about four setae. Prehypopleural sclerite usually dark, with four setae; posthypopleural sclerite usually light colored, with four setae. Eusternal sclerite weak, with two to three setae on each side. Sternellar sclerite minute, with a single seta.

*First to seventh abdominal segments* (figs. 4, 5, 21).—Interior prescutal sclerites fused in the middle line, light colored, with about four setae on each side; exterior prescutal sclerite distinct, dark colored, with about five setae; between interior and exterior prescutal sclerites a single seta present. Interior scuto-scutellar sclerites fused, light colored, with about four setae on each side; exterior scuto-scutellar sclerite distinct, dark-colored, armed with about three setae. Parascutal area with a distinct but small anterior sclerite and a rather large posterior sclerite; both dark colored, anterior armed with two setae, posterior with about five. Epipleural sclerite rather large, light colored, about seven setae. Hypopleural sclerite rather dark, about four setae. Eusternal sclerites fused or almost fused in the sagittal line, on each side about three setae. Sternellum (plus parasternum) having one distinct, dark sclerite armed with about two setae.

*Eighth abdominal segment*.—Similar to the preceding abdominal segments but not so wide and high as these and with the interior and exterior scuto-scutellar sclerites all fused together into a single compound sclerite, armed with about five setae on each side.

*Ninth abdominal segment* (figs. 4, 5).—Pygidial shield semicircular in outline with margin thick and set off from the discal part by a groove. Setae numerous, arranged in a single anterior row and an irregular double row in the free margin; a few setae present in the discal part. Ventral part of segment with a transverse, elongate sclerite.

*Tenth abdominal segment.*—Anteriorly carrying a transverse, narrow unpaired sclerite; on each side a lateral, paired, small, and more rounded sclerite armed with a few setae.

*Leg* (fig. 5).—Coxa black; trochanter, femur, and tibia reddish brown with black distal ends; claw black.

*Habits.*—Feeds on the leaves of most species of elm (*Ulmus*), skeletonizing them from below, at times completely denuding the trees. Transforming to pupa at the bases of trunks or in crevices in the ground, etc.; no cocoon.

*Literature.*—

BRITTON, W. E.

1907. Connecticut Agr. Exp. Stat., Bull. 155.

MARLATT, C. L.

1908. U. S. Dept. of Agr., Bur. Ent., Circ. No. 8, new ed. (Species introduced into United States about 1837.)

SILVESTRI, F.

1910. Boll. Lab. Zool. R. Scuola Super. Agr. Portici, vol. 4, pp. 246–290. (Eggs, the three larval stages, pupa, imago; life-history; seasonal history; parasites, *Lebia scapularis* feeding on eggs, larvae, and pupae of the species; many figures of habitus and details.)

HERRICK, GLEN W.

1913. New York, Cornell Univ. Agri. Exp. Sta., Bull. 333, p. 491.

WOODS, W. C.

1924. Maine Agric. Exp. Sta., Bull. 319, p. 136.

#### GALERUCELLA species

(U. S. Nat. Mus.; described from larva in vials marked: "Galerucella sp., destroying elms, Nanking, China, June 13, 1911. Rec. by U. S. Dept. Agri., July 10, 1911, from A. W. Bowler (?) of the University of Nanking.") Not reared.

Length about 12 mm. The larva of this species is slightly different from the larva of *G. luteola*, as known in this country, the setae of the undetermined species being somewhat stronger and the color of the body being clear lemon-yellow with a single, broad, median, longitudinal, black band. The sclerites are all black and a rather large black spot in the skin surrounds the abdominal spiracles. The pygidial shield is yellow with black marks in the discal part.

#### GALERUCELLA VIBURNI Paykull

(U. S. Nat. Mus.; larvae described from vial marked: "Donse, Seeland, Denmark; larvae found June 7, 1896; imago developed July 4, 1896; E. A. Rosenberg leg. et ded.") Reared.

*Mature larva* (fig. 23).—About 8 mm. long.

Head shining dark brown, labrum black with an anterior, light-brown median spot. Body with membranous parts greenish yellow; prothoracic shield light yellowish with dark chitinous specks, me-

dianly and posteriorly with a moderately large, pale-brown region (somewhat larger than one of the compound interior prescutal sclerites of mesothorax and metathorax), sagittal line distinct and whitish; sclerites on the upper side of mesothorax, metathorax, typical abdominal segments and the pygidial shield pale brown; under side of body creamy yellow with light-brown sclerites; legs shining, dark brown.

Setae moderately long, moderately strong, light brownish and somewhat club-shaped terminally; present in limited number on the back and sides of the larva.

*Head capsule*.—With only slight depressions in frons.

*Labrum* (fig. 32).—Subrectangular, about two and one-half times as wide as long, middle of anterior margin slightly emarginate and anterior corners strongly arcuate. Discal setae moderately long and pointed. Marginal setae minute.

*Mandible* (fig. 27).—With five claw-shaped teeth; inner margin behind last tooth slightly incurved; fourth and fifth teeth somewhat fused at bases, fourth tooth much stronger than fifth. Penicillus present; two short setae externally.

*Maxilla*.—With lacinia distally pectinate, carrying a row of sub-cylindrical, terminally obtuse, strong setae of uniform and considerable length; galea with about six spinelike setae and a small, cone-shaped tactile appendix.

*Postlabial band*.—Simple, rounded, slightly curved forward in the middle.

*Prothorax* (fig. 23).—Prothoracic shield on each side having a large, flat depression with half a dozen round pits in the bottom; five well-developed setae in the anterior margin, one laterally and two posteriorly. Epipleural sclerite large, with two or three setae. The prehypopleural sclerite (=episternum) and the posthypopleural sclerite (=epimeron) of about the same size, the prehypopleural sclerite somewhat darker near the articulation of the leg, each sclerite with two setae. Eusternal and sternellar sclerites almost fused to one plate, two setae on each side.

*Mesothorax and metathorax* (fig. 23).—All the sclerites of moderate size; compound middorsal sclerites separated sagittally by a fine white suture. Prescutal area with interior compound sclerite carrying one seta on each side; exterior sclerite distinct, one seta. Scuto-scutellar area with interior compound sclerite almost identical with interior prescutal, one seta on each side; exterior scuto-scutellar sclerite almost twice as large as exterior prescutal, one seta present. Alar sclerite large, with three setae. Spiracular area chitinized, with one seta. Epipleural area with a moderately large, rounded sclerite, one seta. Prehypopleural and posthypopleural sclerites as in pro-

thorax. Compound eusternal sclerite subrectangular, two setae on each side. Sternellar sclerite minute, and with a single seta.

*First to seventh abdominal segments* (fig. 23).—The skin between the sclerites rather well developed and the sclerites not so predominating in size as in other species of the genus *Galerucella*. Compound interior prescutal sclerite with one seta on each side; exterior prescutal sclerite distinct, one seta. Compound interior scuto-scutellar sclerite not so wide as the interior prescutal plate, one seta on each side; exterior scuto-scutellar sclerite nearer the middle line than the exterior prescutal, one seta. Parascutal area with a distinct anterior sclerite, a distinct posterior sclerite which is twice as large, and a small chitinization around the spiracle; anterior sclerite with one seta and posterior with one. Epipleural sclerite round, large, with two setae. Hypopleural sclerite small; one seta. Eusternal compound sclerite oval, about of the same size as in mesothorax and metathorax; one seta on each side. Sternellar area with small, round sclerite, and one seta.

*Eighth abdominal segment*.—Similar to the preceding segments but with interior and exterior scuto-scutellar sclerites fused into a single median plate; two setae on each side.

*Ninth abdominal segment*.—Pygidial shield with the free margin forming an arc of about 120°. Five long, pointed, marginal setae on each side and two small discal setae on each side. Ventral part of segment with a transverse, band-shaped sclerite; two setae on each side.

*Tenth abdominal segment*.—Carrying a lateral sclerite on each side; four anal lobes.

*Habits*.—Skeletonizes and eats holes through the leaves of *Viburnum opulus* and of cultivated species of *Viburnum*. No definite record as to where the larva pupates.

*Literature*.—

HENRIKSEN, K. L.

1927. Danmarks Fauna No. 31, p. 347.

#### GALERUCELLA NOTATA Fabricius

(U. S. Nat. Mus.; described from larvae in vials marked: "On *Eupatorium perfoliatum*, August 25 to September 14, 1915, and July 14, 1916. Reared and collected material. North East, Pennsylvania, R. A. Cushman." Material contains pyriform eggs in small groups on leaves; first, second, and third larval instars, cast skins of all instars; pupa, cocoon, and reared imagines.)

*Mature larva* (fig. 24).—About 7 mm. long.

Head shining, creamy white to light brown with labrum, clypeal chitinizations, epistoma and a round spot around ocellus olive green; fine sagittal line of frons dark, frontal sutures whitish. Body

with membranous parts creamy yellow,<sup>15</sup> chitinous parts, including the prothoracic and pygidial shields, light yellow, cups carrying the setae large and olive green, dorsal sagittal line of thoracic segments not distinct on account of the light color of the chitinizations; under-side of body creamy white, membranous and chitinous parts having approximately same color; legs light brown with the inner sides creamy yellow and the ends of the joints and the claws darker.

*Setae* (fig. 30).—Moderately long, about half as long as a body segment, moderately strong, creamy yellow and capitate; present in limited numbers on the back of the larva and each inserted on top of a small, dark, tubercle-shaped cup.

*Head capsule*.—With only a slight, median, unpaired depression in frons.

*Labrum* (fig. 33).—Crescent shaped, about twice as wide as long, slightly emarginate anteriorly in the middle. Discal setae moderately long and pointed; marginal setae minute and fine, the two exterior of the row somewhat larger than the others, straight and pointed; a single small seta inserted in front of and another immediately behind the interior discal seta.

*Mandible* (fig. 29).—With five teeth; inner margin behind last tooth projecting into a thin blade with anterior end obtusely rounded; first tooth comparatively strong, with the tip reaching about to the base of second tooth; second and third teeth the larger, claw shaped, and slender; fourth and fifth small, of the same size, and fused except terminally. Penicillus well developed; two setae located externally, and one seta in the middle of the dorsal side.

*Maxilla*.—With lacinia distally carrying a single row of equally long, well developed, distally pointed setae; galea with half a dozen spinelike setae, as many minute setae, and a cone-shaped tactile appendix of about the same length as the longer setae.

*Postlabial band*.—Simple, rounded, not curved forward medianly.

*Prothorax* (fig. 24).—Prothoracic shield on each side having an irregular depression with six deep, round pits in the bottom, a transverse, shallow groove connecting the depressions of the two sides, and at each end of the sagittal line a small triangular unpaired deepening. Arrangement of setae on each side of the shield as follows: Six setae in two rows in the anterior margin, about three setae laterally and two setae in the posterior margin. Epipleural sclerite large, round, with one primary and two or three secondary setae. Prehypopleural and posthypopleural sclerites (=episternum and epimeron) about of the same size; each with one seta. Eusternal and

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<sup>15</sup> In some specimens of this species the creamy color of the skin has changed to a swarthy color, against which the whitish chitinizations contrast sharply, giving these specimens a general appearance strikingly similar to the larvae of *Monoxia puncticollis* (Say).

sternellar sclerites almost fused into one plate, very thinly chitinized, and rather easily overlooked; two or three setae on each side.

*Mesothorax and metathorax* (fig. 24).—Prescutum with compound interior sclerite carrying two setae on each side; exterior sclerite distinct, with one seta. Scuto-scutellum with compound interior sclerite carrying two setae on each side; exterior sclerite large, distinct, and with three setae. Alar area with a large, distinct sclerite, carrying three setae. Spiracular area chitinized, with three setae. Epipleural sclerite carrying one seta. Prehypopleural and posthypopleural sclerites as in prothorax. Eusternal compound sclerite with two setae on each side. Sternellar sclerite minute, and with one seta.

*First to seventh abdominal segments* (fig. 24).—The skin between the sclerites well developed, the sclerites of moderate size. Prescutum with compound interior sclerite bearing three setae on each side; exterior sclerite distinct, and with one seta. Scuto-scutellum with compound interior sclerite bearing one seta on each side; exterior sclerite distinct, rather large, and bearing three setae. Parascutal area without anterior sclerite, without chitinization around the spiracle and with only posterior sclerite present, carrying two setae. Epipleural sclerite round, somewhat projecting, with three or four setae. Hypopleural sclerite small, with two setae. Eusternal compound sclerite with two setae on each side. Sternellar area with a small sclerite, carrying two setae.

*Eighth abdominal segment*.—Similar to preceding segments, but with the interior and the exterior scuto-scutellar sclerites fused into a single plate, carrying three setae on each side.

*Ninth abdominal segment*.—Pygidial shield small, semicircular, half as wide as eighth abdominal segment; five setae on each side in the free margin and two or three on each side of the disk. Ventral side with a transverse, band-shaped, unpaired sclerite; three setae on each side.

*Tenth abdominal segment*.—With one small unpaired posterior anal lobe, one small unpaired anterior anal lobe, and one large lateral anal lobe on each side.

*First and second larval instars*.—Mandibles and other mouth parts shaped as in mature larva; thoracic and abdominal sclerites also present in the same number, arranged in the same way, and carrying as many setae as in the mature larva; likewise possessing capitate setae.

*Habits*.—Feeding on leaves of *Eupatorium perfoliatum*. Transforms to pupa in an oval cocoon formed by an open network of filaments, attached to a leaf.

*Literature.*—

WOODS, W. C.

1924. Maine Agr. Exp. Sta. Bull. 319, p. 137. (Gives only the locality and food plant of larva; no description or figures, and the writer says (p. 138) that he does not know the seasonal history of the species.)

**GALERUCELLA CRIBRATA** LeConte

(U. S. Nat. Mus.; larva described from vials marked: "On *Solidago altissima*, Springfield, Mass. Dimmock No. 1685."—Material contains: (1) Pyriform, brownish-ochreous eggs, 1 mm. long by 0.7 mm. in diameter, with surface consisting of regular hexagons with depressions in the middle; eggs deposited in large number from July 12 to 22, 1890, in groups of 1 to 12 in a place near the base of the root leaves of the food plant, sometimes on the upper surface, sometimes on the lower. In hatching the larva eats away the small, upper, free end of the egg, leaving the large portion of the shell attached to the leaf (from notes of Dimmock); (2) newly hatched larvae; (3) full-grown larvae—1685a—taken July 15, 1900; (4) pupa and cocoon.)

*Mature larva.*—About 7 mm. long.

Head shining, light yellow to light brown, with light-brown labrum. Body with membranous part greenish white, chitinous parts creamy yellow, with the small tubercle-shaped setal cups darker; legs creamy yellow, with brown claws.

Setae moderately long, most of them about half as long as a body segment.

The shape of the headcapsule, mandibles, and the other mouth parts, the form of the prothoracic shield and the number of its setae, the development and number of the mesothoracic and metathoracic sclerites and the number of their setae, the abdominal sclerites and their setae, the pygidial shield and tenth abdominal sclerite exactly as in *Galerucella notata*; in fact, the two species can not be separated in their larval stages by any structural characters.

*Habits.*—Feeding on the leaves of different species of *Solidago*, but, according to W. C. Woods, is seemingly confined to species of the subgenus *Virgaurea*. Pupates in an oval cocoon formed by an open network of filaments and attached to a leaf.

*Literature.*—

WOODS, W. C.

1924. Maine Agr. Exp. Sta. Bull. 319, p. 137.

**MONOXIA PUNCTICOLLIS** (Say)

(U. S. Nat. Mus.; described from larva in vial marked: "Sugar beet, Rocky Ford, Colorado, June 2, 1902. U. S. Chittid.") Reared.

*Mature larva* (fig. 7).—About 8 mm. long.

Head moderately shining, brown to blackish, with unicolorous dark labrum. Body with membranous parts dark olive green and



chitinous parts pale yellow, setal cups not particularly darker than the sclerites, legs shining, generally blackish brown to black.

Setae (fig. 47) rather short, varying from about one-eighth of the length of a normal body segment to about one-quarter of its length; some setae capitate, others pointed; some pale, others dark. Setal cups rather inconspicuous.

The shape of the head capsule, of labrum, mandible, and other mouth parts (figs. 39, 68), the development of the thoracic and pygidial shields and of the sclerites, the arrangement and form of the setae completely agreeing with the corresponding parts in the larvae of *Galerucella notata* and *Galerucella cribrata*, except in unimportant minor variations in the number of the setae on some of the sclerites.

*Taxonomic comments.*—The propriety of establishing the genus *Monoxia* as distinct from the genus *Galerucella* is not substantiated by the features observed in the larva of the type species *Monoxia puncticollis*, as this larva is distinguished from the larvae of *Galerucella notata* and *cribrata* by the mere specific characters of having relatively smaller setae and dark-colored skin. Moreover, in respect to the latter character it should be remembered, as mentioned on page 24, that some specimens of the larvae of *Galerucella cribrata*, preserved in the United States National Museum, possess a coloration of the skin varying from slightly more grayish than in the normal creamy yellow larva to dark olive green as in *Monoxia puncticollis*.

The larva of the species *Monoxia consputa*, however, is entirely different from this larva of *Monoxia puncticollis*, positively can not be placed in the same genus with it, and a new genus will probably have to be created for it. Further discussion on the taxonomic position of *Monoxia consputa* will be found where the species is treated on page 29.

*Habits.*—The larva of *Monoxia puncticollis* is injurious to sugar beets, skeletonizing or eating through the leaves and often completely devouring young plants of considerable size. Other food plants are *Chenopodium album*, *Dondia erecta*, and *Salsola pestifer*. It pupates in a simple excavated cell in the ground, in this regard differing from *Galerucella notata* and *G. cribrata*, which form a reticulate cocoon above the ground.

*Literature.*—

CHITTENDEN, F. H., and MARSH, H. O.

1920. U. S. Dept. of Agr. Bul. 892 (The Beet Leaf Beetle). Professional paper from Bureau of Entomology. (Eggs attached in clusters to leaves of food plants; young larva with dark brown thoracic shield, gray skin and rather dark sclerites, hairs comparatively longer than in mature larva. List of literature.)

## MONOXIA CONSPUTA LeConte

(U. S. Nat. Mus.; described from larva in vial marked: "Hubbard Note No. 636, *Monoxia consputa* (?) 4th July, 1891, Syracuse Salt Vats, Great Salt Lake, Utah." Not reared. An imago of the species is placed by Hubbard in the vial together with three larvae. No other larval material of this species is preserved in the Museum, but Mr. Hubbard's well known disinclination to name a larva when it was not reared or fairly well associated with imago warrants the probable correctness of the determination. Moreover the *Monoxia consputa* larva is the only known mining galerucine larva and the specimens in question are without doubt galerucine larvae and adapted to mining in soft plant tissue.)

*Mature larva* (fig. 9).—About 6 mm. long.

Head moderately shining, grayish yellow with blackish colored margins and blackish epicranial midline; labrum grayish. Body light gray, membranous parts predominate; prothoracic shield light amber colored anteriorly and on the top of a posterior transverse, rounded crest; pygidial shield slightly amber; rest of the sclerites of the body very thin, gray, like the skin, and to be seen only by close examination; legs shining, light amber, with darker margins at the ends of each joint; claws amber.

Setae in general minute; viewed under considerable magnification (figs. 8, 52), short and club shaped. Pointed and either moderately long or short setae present on the head, shields, legs, and epipleural lobes.

*Head capsule* (fig. 40).—With hind corners of epicranium strongly produced posteriorly. Frons small, almost hexagonal, inwardly strengthened in the middle line by a dark colored, Y-shaped thickening.

*Labrum* (fig. 41).—Transversely oblong, about two and one-half times as wide as long, front margin straight; discal setae pointed, moderately long; marginal setae short and pointed.

*Mandible* (fig. 51).—Provided with five claw-shaped teeth; the second and third larger; first, fourth, and fifth all distinct and rather strong; inner edge of mandible immediately behind the last tooth produced into a small, triangular, anterior projection. Penicillus well developed; no setae found on the back of the mandible.

*Maxilla* (fig. 65).—With lacinia and galea carrying short, small lanceolate setae; tactile appendix of galea small. Maxillary palpus three jointed.

*Postlabial band*.—Broadly U-shaped, with a slight enlargement of the chitin in the middle.

*Prothorax* (fig. 9).—The prothoracic shield rather bulging and divided by a median transverse groove into two slightly chitinized portions; a few either short or moderately long, pointed setae present in the anterior and the posterior margins.

*Mesothorax and metathorax*.—Without distinct sclerites; setae minute and club shaped.

*First to eighth abdominal segments* (fig. 9).—Without distinct sclerites; setae dorsally few, minute, and club shaped; laterally with a single moderately long, pointed seta in epileurum.

*Ninth abdominal segment* (fig. 8).—With a rather small, miter shaped in outline, slightly chitinized pygidial shield carrying moderately long, pointed marginal setae.

*Tenth abdominal segment*.—In common with the other galerucine larvae developed as a strong pygopod.

*Leg* (fig. 9).—With the paronychial appendix only about half as long as the claw.

*Habits*.—Found mining inside of the leaves of *Chenopodium album* and a perennial *Atriplex* species, at King City, Calif. (according to unpublished notes made in 1918 by C. F. Stahl, of the Division of Truck Crop Insect Investigations, Bureau of Entomology, United States Department of Agriculture) and also in *Grindelia* (according to Essig: Insects of Western North America). No injury to sugar beets known from the larvae, though the imagines seriously injure the tops of the beets. No records as to where the larvae pupate.

*Taxonomic comments*.—The larva of *Monoaxia consputa* is essentially different not only from the larva of *Monoaxia puncticollis* but from other larvae of the subfamily Galerucinae, to which, however, it unquestionably belongs. It represents a separate generic type of the Galerucinae and is distinguished by a series of characters peculiar to many mining larvae, particularly of the subfamily Halticinae, namely, a strongly built frons, extraordinarily long posterior prolongations of epicranium, the absence from the typical body segments of distinct sclerites with well-developed setae, and unusually short paronychial appendices.

*Literature*.—

ESSIG, E. O.

1926. Insects of Western North America, New York, MacMillan Co., p. 473

#### LOCHMAEA CAPREAE Linnaeus

(U. S. Nat. Mus.; described from a single, newly hatched larva in alcohol, bought in August, 1922, from Dr. K. W. Verhoeff, determined by him and marked "South Germany; K. W. Verhoeff.")

*First larval instar* (fig. 6).—About 1.5 mm. long.

Head yellowish brown with dark brown margins and a dark brown median carina; labrum creamy yellow anteriorly, yellowish brown posteriorly. Body having the membranous parts greenish yellow; prothoracic shield uniformly yellowish brown with the sagittal line whitish and distinct; sclerites of mesothorax and meta-

thorax, the typical abdominal segments and the pygidial shield also yellowish brown, underside of body lighter, legs shining and yellowish brown.

*Setae*.—Long, whitish, either capitate or pointed, present in a rather limited number on the back and sides of the larva.

*Head capsule*.—With slight depression in frons.

*Labrum*.—About twice as wide as long, with entire front margin regularly arcuate without emargination in the middle; discal setae moderately long and pointed, marginal setae minute.

*Mandible*.—With second, third, and fourth teeth large and claw shaped; first and fifth very small. Penicillus and setae not found on the specimen at hand.

*Maxilla*.—Having lacinia armed dorsally with a single row of strong, subcylindrical, terminally rather obtuse setae, all of about same length; galea with many spinelike setae and a well-developed tactile cone.

*Postlabial band*.—Rounded, medianly slightly enlarged and curved forward.

*Prothorax* (fig. 6).—Prothoracic shield with five marginal setae anteriorly, one laterally, and two posteriorly. Epipleural sclerite large, with two setae. Prehypopleural and posthypopleural sclerites (=episternum and epimeron) well developed and of the same size. Eusternal and sternellar sclerites almost fused to one plate, with two setae on each side.

*Mesothorax and metathorax*.—Having all the sclerites of moderate size; compound middorsal sclerites separated sagittally by a fine, white suture. Prescutal area with interior compound sclerite carrying one seta on each side; exterior sclerite small and without seta. Scuto-scutellar area with interior compound sclerite almost identical with the interior prescutal, one seta on each side; exterior sclerite about twice as large as the exterior prescutal, one seta present. Alar sclerite large, with three setae. Spiracular area chitinized, with one seta. Epipleural area with a moderately large sclerite, one seta. Prehypopleural and posthypopleural sclerites as in prothorax. Compound eusternal sclerite subrectangular, two setae on each side. Sternella paired, sclerite not found.

*First to seventh abdominal segments*.—The skin between the sclerites rather well developed, and the sclerites of moderate size. Compound interior prescutal sclerite with one seta on each side; exterior prescutal sclerite distinct, one seta. Compound interior scuto-scutellar sclerite narrower than the interior prescutal sclerite, one seta on each side; exterior scuto-scutellar sclerite nearer the middle line than the exterior prescutal, one seta. Parascutal area with no anterior sclerite, a distinct posterior sclerite with one seta, and no dis-

tinct chitinization around the spiracle. Epipleural sclerite with two setae. Hypopleural sclerite rather small, with one primary and one smaller secondary setae. Eusternal sclerite with one seta on each side, sternellar sclerite indistinct.

*Eighth abdominal segment.*—With interior and exterior scuto-scutellar sclerites fused into a single plate carrying two setae on each side.

*Ninth abdominal segment.*—Pygidial shield with free margin regularly arched. Five long, pointed setae on each side in or near the margin; primary discal setae not developed.

*Tenth abdominal segment.*—Normally developed.

*Habits.*—Skeletonizes and eats holes through the leaves of species of *Salix* and *Betula*. Pupates in the ground.

*Taxonomic comments.*—In general the larva of *Lochmaea capreae* is very similar to the larva of *Galerucella viburni*, as a comparison between the above-given descriptions will show; they differ, however, in the two following characters: The exterior prescutal sclerite of mesothorax and metathorax is without a seta in *Lochmaea capreae* but carries one seta in *Galerucella viburni*, and the anterior parascutal sclerite is absent in the abdominal segments of *capreae* but present and carrying one seta in *viburni*. There is, as far as the larva is concerned, slight reason for the creation of a separate genus for *Lochmaea capreae* as it is nearer to some of the species of the genus *Galerucella*, for instance *G. viburni* and *G. notata* than these latter are to other species of their own genus, particularly *G. luteola* and *G. nymphaeae*.

*Literature.*—

HENRIKSEN, K. I.

1927. Danmarks Fauna No. 31, p. 346. (The author did not have a specimen of the larva before him and therefore has only quoted the few vague and incorrect statements found in the literature; for instance, that it is similar to the larva of *Melasoma populi*, which is not the case.)

#### GALERUCA TANACETI Linnaeus

(U. S. Nat. Mus.; described from a larva in a vial marked: "Larvae found 26 June, 1895; pupa 4 July, 1895; imago developed 12 June, 1895. Skovrød Dam, near Copenhagen, Denmark. E. A. Rosenberg legit and dedit").

*Mature larva* (fig. 10).—From 12 to 14 mm. long.

Head shining, blackish brown, labrum unicolor; frontal sutures whitish with an elongate whitish spot adjacent to their anterior halves and often with a large whitish spot dorsally at each ocellus; margins of head capsule, epistoma included, shining black. Sagittal carina of frons indicated by a fine black line, each ocellus surrounded by a ringshaped blackish spot. Body on the upper side having

the skin, the thoracic and the pygidial shields, and the rest of the sclerites blackish brown, on the under side greenish gray; immediately after a molt the color of the larva is bright yellowish brown; legs shining black.<sup>16</sup>

Setae long, about half the length of a normal segment, creamy white, slightly capitate, present in considerable numbers, and radiating in all directions from conical elevations of most sclerites on the upper side of the body.

*Head capsule* (fig. 42).—With middle of frons slightly depressed transversely; setae pointed, either moderately long or long.

*Labrum* (fig. 42).—Having an arcuate free margin with a small but relatively deep emargination in the middle; exterior discal seta on each side pointed and as long as the width of labrum, interior discal seta about half as long, marginal setae short and fine.

*Mandible* (fig. 53).—Provided with five teeth; first rather short and thin; second, third, and fourth larger and provided with serrated edges; fifth, well developed, broad and pointed but not serrated, appearing as a direct anterior prolongation of the inner edge of the mandible. Penicillus absent. Two long seta on the back and a small sensory ring.

*Maxilla* (fig. 69).—Lacinia distally with a row of five, strong, lanceolate setae. Galea terminally chitinized, carrying about half a dozen setae similar to those of lacinia but irregularly arranged and with a cone-shaped tactile organ between them.

*Postlabial band* (fig. 70).—Semicircular, medianly slightly bent forward and enlarged.

*Prothorax* (fig. 10).—Shield with discal part transversely depressed and marginal parts thick and elevated; sagittal line present, whitish, and slightly enlarged in the middle. Numerous long setae inserted in two or more rows in the whole marginal region; inside of this only a few present. Epipleural area with a large rounded sclerite carrying about 10 moderately long setae radiating in all directions. Prehypopleural sclerite (=episternum) somewhat protuberant, with about half a dozen setae; posthypopleural sclerite (=epimeron) also somewhat protuberant, carrying about three setae. Eusternal unpaired sclerite and the two sternellar sclerites fused into a single trapezoidal, often medioposterity split, plate with three or four short setae on each side.

*Mesothorax and metathorax* (fig. 10).—Interior prescutal sclerite distinct, not fused with the corresponding sclerite of the opposite side of the body, arising into a well-developed conical tubercle about

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<sup>16</sup> Newly hatched larva is very similar to the mature, but somewhat lighter brown, with proportionately longer hairs, and without distinct conical elevations, from any of the sclerites.

twice as high as wide at base and carrying six setae; exterior prescutal sclerite distinct, somewhat smaller than the interior, with a tubercle carrying three setae. Interior scuto-scutellar sclerite distinct carrying five setae on its tubercle; exterior scuto-scutellar sclerite distinct, tubercle with about six setae. Alar sclerite large, with about 10 setae. Spiracular area with a sclerite surrounding the spiracle; about four small setae present. Epipleural area triangular with an oval sclerite carrying five or six setae. Prehypopleural sclerite flat, heavily chitinized, with one or two small, pointed setae; posthypopleural sclerite somewhat protuberant, carrying about three small setae. Eusternal sclerite large, oval, convex, with about 10 setae on each side. Each sternellar sclerite distinct but small, carrying one seta.

*First to seventh abdominal segments* (fig. 10).—Interior prescutal sclerites distinct, not fused in the sagittal line, number of setae on each sclerite about six; exterior prescutal sclerite of moderate size and separated from the interior sclerite by a distance equal to about three times its own diameter, tubercle carrying about three setae. Interior scuto-scutellar sclerite distinct, with about five setae; exterior scuto-scutellar sclerite closer to the sagittal line than the exterior prescutal, about four setae present. Parascutal area without anterior sclerite; posterior sclerite large, carrying 8 to 10 setae; spiracle not located in a distinct sclerite. Epipleural sclerite large, protuberant, and having seven or eight setae. Hypopleural sclerite with about five setae. Eusternum with a large sclerite, carrying four or five setae on each side. Parasternal lobe (=coxal lobe, Hopkins) present, having a round sclerite with four setae. Sternellar sclerite paired, small, distinct, with one seta.

*Eighth abdominal segment* (fig. 13).—Interior prescutal sclerite distinct, not fused medianly with that of the opposite side, number of setae four or five; exterior prescutal sclerite with three setae. Interior and exterior scuto-scutellar sclerites fused into a single, medial sclerite, carrying six setae on each side. Posterior parascutal sclerite distinct, with about eight setae. Segment otherwise similar to the preceding segments.

*Ninth abdominal segment* (fig. 13).—Pygidial shield comparatively small, half as wide and somewhat shorter than the eighth abdominal segment, approximately semicircular in dorsal outline; anteriorly and along the free margin swollen and with the anterior and marginal posterior parts of the shield separated by a transverse, crescent-shaped depression. Setae numerous, arranged in a single anterior row with two setae on each side, and an irregular double row in the free margin with from 8 to 10 setae on each side; setae generally almost as long as the sagittal length of the shield. Ventral part of

segment bearing a single, transverse, elongate sclerite with five setae on each side.

*Tenth abdominal segment*.—On each side with a lateral sclerite carrying minute setae.

*Habits*.—Feeding on the leaves of *Achillea millefolia*, *Cardamine pratensis*, *Cerastium*, and other low-growing plants.

Pupates in the ground.

*Literature*.—

HENRIKSEN, K. L.

1927. Danmarks Fauna, No. 31, p. 345.

#### GALERUCA LATICOLLIS Sahlberg

(U. S. Nat. Mus.; described from a mature larva in vial marked: "On flowers of *Thalictrum flavum*, 3d July, 1914. Damhus Sö, near Copenhagen; J. P. Kryger legit et dedit." Vial contains larvae of different stages, pupae and reared imagines.)

*Mature larva*.—About 14 mm. long.

The general color and the structural characters the same as in *Galeruca tanacetii* with the following exceptions:

(1) Sclerites on upper side of mesothorax and metathorax and on the abdominal segments broader at base and less projecting than in *tanacetii*.

(2) Setae somewhat shorter than in *tanacetii* and more yellowish brown.

(3) Exterior prescutal sclerite of an abdominal segment comparatively large, and separated from the interior prescutal sclerites by a distance about equal to its own diameter; carrying four setae.

(4) Interior scuto-scutellar sclerite of an abdominal segment fused with the corresponding sclerite on the opposite side of the body into a single, compound medial sclerite (fig. 11). The corresponding sclerites are separate in *tanacetii*.

(5) Interior prescutal sclerites of eighth abdominal segment fused or almost fused; conical elevations low and obtuse. Same sclerites distinctly separate and produced into conspicuous tubercles in *tanacetii*.

*Habits*.—Feeding on the leaves of *Thalictrum flavum* and *Aconitum*.

Pupates in the ground.

*Literature*.—Larva not formerly described.

#### GALERUCA POMONAE Scopoli

(U. S. Nat. Mus.; described from a larva contained in vial marked: "Found 2d June, 1905; developed into imago 21 June, 1905. Tis Sö, Denmark, E. A. Rosenberg legit and dedit.")



*Mature larva.*—About 14 mm. long. The general color and the structural details the same as in *Galeruca tanacetii* and *G. laticollis* with the following exceptions:

(1) Sclerites on upper side of mesothorax and metathorax and of the abdominal segments generally somewhat smaller at bases and projecting into tubercles as high or higher than in *tanacetii*. Sclerites much smaller and much higher than in *laticollis*.

(2) Setae yellowish brown, much shorter than in *tanacetii* and somewhat shorter than in *laticollis*.

(3) Exterior prescutal sclerite of an abdominal segment very small and separated from the interior prescutal sclerite by a distance about five times its own diameter, carrying one or two setae (fig. 12). In *tanacetii* the distance between exterior and interior prescutal sclerites is about three times the diameter of the exterior sclerite and in *laticollis* the same distance is about equal to the length of the diameter of the exterior sclerite.

(4) Interior scuto-scutellar sclerites of an abdominal segment separate as in *tanacetii*; not fused with those on the opposite side of the body as in *laticollis*.

(5) Ninth abdominal segment with a much larger fleshy region anterior to a shorter and broader shield than in both *tanacetii* and *laticollis*.

*Habits.*—In Europe, according to Kaltenbach,<sup>17</sup> feeding on leaves near the roots of *Centaurea jacea*, *Scabiosa succisa*, and *Circium palustre*. In Illinois, according to John J. Davis, feeds exclusively on *Phlox divaricata* (F. Knab mentions also *Dentaria laciniata* as a food plant for specimens collected at Urbana, Ill.). Larva digs, according to J. J. Davis, an inch or less into the ground before pupation, forming there a cocoon of a few silken threads with particles of earth interwoven.

#### *Literature.*—

DAVIS, JOHN J.

1907. Life history and habits of *Galeruca pomonae* Scopoli in Illinois (Ent. News, vol. 18, 269–275, one plate).

#### SERMYLASSA HALENSIS Linnaeus

(U. S. Nat. Mus.; described from a mature larva in vial marked: "No. 280, from Meinert, 1890, ex Coll. Zool. Mus. Copenhagen." Newly hatched larva kept in vial marked: "South Germany, Dr. K. W. Verhoeff Coll. Bought August, 1922.")

*Mature larva* (fig. 14.)—About 10 mm. long.

Head shining, yellow, region around ocellus and antenna more whitish; labrum unicolor yellow; frontal sutures whitish; margins

<sup>17</sup> Pflanzenfeinde, p. 315.

of head capsule, epistoma included, shining dark brown; sagittal carina of frons indicated by a thin black line. Body with the skin creamy white, the thoracic and pygidial shield and the rest of the sclerites shining yellow<sup>18</sup>; legs shining brownish.

Setae moderately long, cream colored to light brown, pointed, present in rather limited number on somewhat convex or flat sclerites.

*Head capsule* (fig. 43).—With frons reaching far back and median epicranial suture short; ratio between length of frontal carina and that of epicranial suture approximately as 4 to 1. Setae fairly long and pointed.

*Labrum* (fig. 43).—With free margin arcuate, medianly incurved.

*Mandible* (fig. 54).—With four well-developed, more or less distinctly serrated teeth; first tooth rudimentary. Penicillus present, two well-developed setae on the back.

*Maxilla* (fig. 71).—Lacinia and galea not appearing (on the two slides prepared) as distinctly separated; setae rather short, thin, and pointed; cone-shaped appendix present.

*Postlabial band*.—Narrow, forming a simple arch.

*Prothorax* (fig. 14).—Shield with discal part smooth and flatly convex, marginal parts thick, slightly elevated and somewhat pitted; sagittal line thin and whitish colored, but owing to the light color of the entire shield not distinct. Setae rather short, arranged in one or a few rows in the marginal region, one or two setae on each side in the discal part. Epipleural area small with a rounded sclerite carrying a single seta. Prehypopleural area (=episternum) with a well developed, somewhat convex sclerite, no seta; posthypopleural area (=epimeron) with a similar sclerite but carrying one seta. Eusternum with a narrow transverse, unpaired sclerite carrying two setae on each side. Sternellar sclerites fused together in the middle line to a small, square, narrow plate, probably including elements of the eusternal sclerite; two setae on each side, one in front of the other. Poststernellar area (=spinisternum, Crampton) triangular, distinct, and somewhat chitinized.

*Mesothorax and metathorax* (fig. 14).—Interior prescutal sclerite almost fused with the interior prescutal sclerite of the opposite side, two setae on each; exterior prescutal sclerite equal in size to the interior one, three setae present. Interior and exterior scuto-scutellar sclerites in form, size, and the number of their setae equal to the interior and exterior prescutal sclerites. Alar sclerite larger, with about five setae. Spiracular area of mesothorax pushed forward and located below the prothoracic shield; spiracular area of metathorax in normal position, one seta present. Epipleural sclerite with one seta. Prehypopleural sclerite (=episternum) somewhat

<sup>18</sup> In newly hatched larva the number of sclerites and setae is similar to that of the mature larvae, but the chitinized parts are brown and the setae proportionately longer.

larger and flatter than in prothorax, no seta; posthypopleural sclerite (=epimeron) convex and similar to that of prothorax, one seta present. Eusternal sclerite crescent-shaped, with two or three small setae. Each sternellar sclerite distinct but small, carrying one seta. Mesothorax with a well developed, chitinized poststernellar area (=spinisternum, Crampton); metathorax without this area.

*First to eighth abdominal segments* (fig. 14).—Dorsally divided into three distinct transverse areas, namely, the prescutum, the scutum, and the scutellum. Ventrally likewise divided into three transverse areas, namely the eusternum, the sternellum, and posternellum, the last-mentioned area forming an intersegmental band. Interior prescutal sclerite fused with the corresponding sclerite of the other side into a single, median, transverse, oval, compound sclerite with two setae on each side; exterior prescutal sclerite well developed, broadly oval to circular, carrying two setae. Scutal sclerite transverse, elongate-oval to lanceolate, in the sagittal line approaching the scutal sclerite of the opposite side but not fused with it, carrying two setae. Interior scutellar sclerite fused with the interior sclerite of the other side into a median, transverse, compound sclerite, in size and form very similar to the prescutal sclerite, two setae on each side; exterior scutellar sclerite distinct, circular, nearer the sagittal line than exterior prescutal sclerite, considerably smaller than the latter and carrying only one seta. Parascutal area with (1) a well developed anterior sclerite carrying one seta, (2) a ring-shaped sclerite surrounding the spiracle located directly behind the anterior sclerite, and (3) a posterior sclerite, twice as large as the anterior sclerite, nearer the sagittal line than this sclerite and carrying two setae. Epipleural sclerite large, convex, with three setae. Hypopleural sclerite similar to the epipleural sclerite, and with three setae. Eusternum with a large, oval, median, unpaired sclerite with three or four setae on each side, and also with an accessory sclerite at each end of the median sclerite; accessory sclerite without setae. Sternellar sclerite (or, probably, parasternal and sternellar sclerites fused) well developed, paired, with two setae. Posternellar sclerite thin and without setae.

*Ninth abdominal segment*.—Pygidial shield smoothly and uniformly chitinized, transverse, elliptical, small, only half as long as wide. Five setae on each side in a single row along the posterior margin, two similar setae in the central portion of the shield. Ventral part of segment with a single, transverse, narrow sclerite with three small setae on each side.

*Tenth abdominal segment*.—With a ring shaped chitinization at base.

*Habits*.—Feeds on *Galium mollugo* and *Galium verum*. Pupates in the ground.

*Literature*.—

HENRIKSEN, K. L.

1927. Danmarks Fauna No. 31, p. 349.

AGELASTICA ALNI Linnaeus<sup>39</sup>

(U. S. Nat. Mus.; described from a mature, probably just molted larva in vial marked "No. 281, from Meinert, 1890, ex Coll. Zool. Mus. Copenhagen." Probably not reared.)

*Mature larva* (fig. 15).—About 11 mm. long.

Head shining, dark brown, with lighter colored regions located anteriorly on frons and around the ocelli; frontal sutures yellowish; margins of head capsule and the carina of frons shining black; labrum unicolored dark. Body with dull, darkish skin; shields, sclerites, and legs shining and generally of the same color as the head capsule; anterior and lateral regions of prothoracic shield more yellowish; a sagittal line on prothorax, mesothorax, metathorax, and the first abdominal segment whitish.

Setae fine, pointed, rather short, light colored, and present in small numbers.

*Head capsule* (fig. 44).—Rather flat; length of frons and epicranial suture about equal; setae rather short and almost white.

*Labrum* (fig. 44).—With regularly arcuate free margin.

*Mandible* (fig. 55).—With three distinct teeth; tooth No. 1 absent, and the projecting anterior portion of the inner edge not developed as a distinct tooth. Penicillus absent; no setae found.

*Maxilla* (fig. 72).—Lacinia carrying about six large, lanceolate setae; galea with rather few, short, and pointed setae, conical appendix short.

*Postlabial band* (fig. 73).—Formed like the letter "W." Labium small; labial palpi close together.

*Prothorax* (fig. 15).—Shield with discal part dark colored, smooth, and flatly convex; marginal parts light, thick, slightly elevated, and having depressions and pits. Sagittal light line very distinct and complete. Setae arranged in a single row anteriorly, but without order in the rest of the marginal region; two or three small setae on each side in the discal part. Epipleural area small and with a single seta. Prehypopleural area (=episternum) rather bulging and with a single seta; posthypopleural area (=epimeron) much larger, otherwise similarly bulging and with a single seta. Eusternal sclerite narrow, transverse, and with several very fine setae. Sternellar

<sup>39</sup> See comments given on p. 40, where Henriksen's description and Boas's figure of this larva are discussed.

sclerites fused into a square median plate with a few setae on each side. Poststernellar area (=spinisternum) triangular, distinct, only slightly chitinized.

*Mesothorax and metathorax* (fig. 15).—Interior prescutal sclerite almost fused with the corresponding sclerite of the opposite side, sagittal light line very distinct, two setae on each side; exterior prescutal sclerite small, with two or three setae. Interior and exterior scuto-scutellar sclerites similar to the interior and exterior prescutal sclerites in size, form, coloration, and the number of setae. Alar sclerite large, with about five setae. Spiracular area of mesothorax pushed somewhat forward and partly located below the prothoracic shield; area normally placed in metathorax; one seta present. Epipleural sclerite with one seta. Prehypopleural sclerite (=episternum) larger, flatter, and more chitinized than in prothorax, one seta present; posthypopleural sclerite (=epimeron) as in prothorax. Eusternal sclerite oval with two or three setae on each side. Each sternellar sclerite with one seta. Mesothorax with a distinct poststernellar area (=spinisternum); metathorax without this area.

*First to eighth abdominal segments* (fig. 15).—Dorsally divided into three distinct areas, namely, prescutum, scutum, and scutellum; ventrally also divided into three areas, namely, eusternum, sternellum, and poststernellum; poststernellum constituting an intersegmental band. Interior prescutal sclerite fused with that of the other side into a single, median, transverse, compound sclerite, on each side with four or five light and thin setae; exterior prescutal sclerite small, carrying a single seta. Scutal sclerite located straight behind exterior prescutal sclerite and like this of small size and carrying but one seta. Interior and exterior scutellar sclerites in size, form, and arrangement similar to the interior and exterior prescutal sclerites. Parascutal area with both the anterior and the posterior sclerites well developed, closely approaching each other, forming together a frame surrounding a large supraspiracular gland, and each having two or three setae. Epipleural and hypopleural sclerites well developed, convex, carrying half a dozen setae. Eusternum with a large, oval, unpaired sclerite carrying three or four setae on each side. Sternellar sclerite distinct, paired, with two setae. Poststernellar area without sclerite.

*Ninth abdominal segment*.—Pygidial shield transverse, elliptical, small, about one-third as wide as long and about half as wide as the eighth abdominal segment; a dozen setae on each side in the margin, and a few setae in the central portion of the shield. Ventral part of the segment with a transverse row of three indistinct sclerites, one medianly located, and one on each side; three small setae on each side.

*Tenth abdominal segment*.—With a ring-shaped chitinization at base.

*Habits.*—Feeding on alder (*Alnus*), more rarely on hazel (*Corylus*), skeletonizing and eating holes in the leaves of young, one- to two-year-old plants. Pupates in the ground just below the surface.

*Literature.*—

BOAS, I. E. V.

1924. Dansk Forstzoologi, 2d edition, p. 405. (The figure of a larva, said to be *Agelastica alni*, does not fit the description given by Henriksen, and is entirely different from the figure of this larva in the present paper. Boas has not described the larva, only mentioned its color, size, and life history.)

HENRIKSEN, K. L.

1927. Danmarks Fauna, No. 31, p. 350. (Henriksen's description agrees with the figures and description of the larva in the present paper. As mentioned above, these figures are made from a specimen originating from the same old and probably not reared material in the Zoological Museum of Copenhagen which Henriksen has studied; but beside this material new, and probably reared, material is preserved in the Copenhagen Museum, collected in 1894 by William Schlick, and 1895 by E. A. Rosenberg. With this material in his hands I consider Henriksen's description and the figures and description here published by myself as correct and Boas' figure as made from a chrysomelid larva belonging to a different genus.)

TAXONOMY OF GALERUCINAE LARVAE AND THEIR RELATION TO HALTICINAE AND CHRYSOMELINAE LARVAE

In the very valuable comprehensive treatment of the chrysomelid larvae, the first of its sort in the world's literature, which K. L. Henriksen has just published in Danmarks Fauna (No. 31, pp. 290–376), the author writes, on page 314, that it is not possible to find definite characters by which the larvae of the three subfamilies, "Cyclici," "Galerucini," and "Halticini,"<sup>20</sup> can be grouped in the same subfamilies as the imagines, and therefore he treats the larvae of these subfamilies collectively.

In a recent paper by myself<sup>21</sup> I have pointed out in a taxonomic discussion (pp. 201–203) that by removing the tribes Diabroticini and Phyllobroticini from the Galerucinae and placing them in the subfamily Halticinae near the tribes Systemini, Crepidoderini, and Psyllioidini it is possible to separate the rest of the larvae into the same two subfamilies as the imagines. Again, judging from our present knowledge, it is not difficult to separate the larvae of each of these two subfamilies from the larvae of Chrysomelinae, as will be shown by the following brief characterization of the three larval types of the subfamilies in question. I therefore believe that in

<sup>20</sup>These terms, applied by Henriksen, correspond to the terms "Chrysomelinae," "Galerucinae," and "Halticinae" used in the present paper.

<sup>21</sup>Proc. Ent. Soc., Washington, D. C., vol. 29, 1927.

reality it is possible to retain, with slight modification, our customary taxonomic arrangement for the larvae.

The larvae of the Chrysomelinae (=Chrysomelini, Cat. Col. Eur., 1906, =Cyclica, Henriksen, with genus *Bromius* excluded) are characterized by having the antenna three-jointed, the ocelli present on each side in a number exceeding one, namely, from four to six, and the labial palpus two-jointed.<sup>22</sup>

The larvae of the Galerucinae (=Galerucae, Cat. No. Eur., 1906, =Galerucini, Henriksen) have the antenna one-jointed and provided with a jointlike tactile papilla, one ocellus on each side, and the coronal (=median epicranial) suture distinct.

The larvae of the Halticinae (=Halticae, Cat. Col. Eur. 1906, =Halticini, Henriksen) have the antenna one- or two-jointed, one ocellus on each side or no ocelli, and the coronal (=median epicranial) suture absent.

Among the Galerucinae larvae *Monocesta coryli* represents an isolated type particularly characterized by the unusual form of the labrum and the mandible and the unique development of the mid-dorsal series of abdominal sclerites (figs. 1 and 2). *Agelastica alni* is the only galerucine larva having abdominal suprspiracular glands and approaches in this respect the Chrysomelinae larvae of *Gastroidea*, *Melasoma*, *Phaedon*, and related genera. It also possesses separate scutal and scutellar areas on the abdomen and, ventrally, well developed intersegmental bands, but these characters are likewise found in *Sermylassa halensis* and are indicated in *Galerucella luteola*. The presence of three transverse tergal areas and intersegmental bands may signify more generalized morphological conditions of the abdominal segments than the presence of only two transverse areas and no intersegmental band, so while the presence of the glands in *Agelastica* suggests some connection with the specialized chrysomeline larvae, the development of the abdominal areas is more in accordance with the development of the same features in several primitive larvae, including in particular the larvae of *Phyllobrotica* and *Diabrotica*.

The common Galerucinae type with united scutal and scutellar areas and no intersegmental bands comes in many respects near to the larva of the tribe Halticini so well interpreted by Woods and Kemner.

From this common Galerucinae type the larva of *Monoxia consputa* appears to deviate greatly but represents in reality merely a biological adaptation of the type to a mining life in soft plant tissues rather

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<sup>22</sup>The larvae of the Eumalpinae, to which genus *Bromius* belongs, have no ocelli and have a one-jointed labial palpus.

than an isolated phylogenetic development. The large triangular posterior prolongations of the epicranium, the strongly chitinized frontal margin and median carina of the head capsule, the soft bulging body with minute setae, and the thinly chitinized flexible pygidial shield are features often found in mining larvae, for instance among the Halticinae in *Dibolia*, *Mantura*, *Argopistes*, and *Sphaeroderma*.

Among the larvae of the common Galerucinae type the larvae of *Trirhabda* and *Galeruca* form well-defined genera, the former characterized particularly by having the abdominal spiracles lodged in large posterior parascutal sclerites and the latter characterized by the conical sclerites from which well developed setae radiate in all directions. On the contrary, the larva of *Monoaxia puncticollis* is very similar to the larva of *Galerucella notata*, and the larva of *Lochmaea capreae* is decidedly closer to the *Galerucella* species *notata* and *viburni* than either of these are to such *Galerucella* species as *luteola* and *nymphaeae*.

Judged from the larvae the genus *Galerucella* includes five groups of species, all five groups characterized in the key (p. 8), namely, A, the *nymphaeae* group; B, the *luteola* group; C, the *viburni* group; D, the *decora-cavicollis* group, and E, the *notata* group. The *nymphaeae* group and the *luteola* group are very distinct, mutually entirely different, but both in different ways sharply separated from the following groups, which are closely related to each other. In the *viburni* group the tergal sclerites are all present and all free, and there are two prescutal, two scuto-scutellar, and two parascutal sclerites on each side. In contrast to this group the *decora-cavicollis* group is characterized by a fusion of the interior and exterior scuto-scutellar sclerite, and thus the species of the *notata* group possess two prescutal, only one compound scuto-scutellar, and two parascutal sclerites on each side. In the *notata* group the difference from the *viburni* group is expressed by the complete absence of the anterior parascutal sclerite, and thus the species of the *notata* group possess two prescutal, two scuto-scutellar, but only one parascutal sclerite on each side.

*Monoaxia puncticollis* has the same arrangement of the sclerites as the *notata* group and also the other features, characteristic of this group, identically developed; it is therefore remarkable that the larva pupates in a simple earthen cell in the ground while the larvae of *notata* and *cribrata* construct an open reticulate cocoon, attached to a leaf of the food plant; this biological circumstance, and the systematic differences between the imagines, seem consequently to prove a less intimate affinity between the species than the structural details of the larvae suggest.



It has been previously mentioned that the larva of *Monoxia consputa* represents an adaptation of the common galerucine type, but it can not be considered as derived from a larva of the *Monoxia puncticollis* type. Unquestionably, it is at present misplaced in the genus *Monoxia*, as it shows no close relation to it, and a new genus should be created for it.

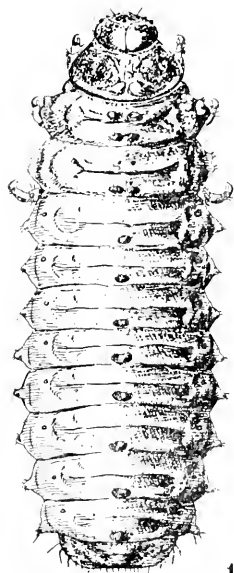
EXPLANATION OF PLATES

(All figures made by the author)

PLATE I

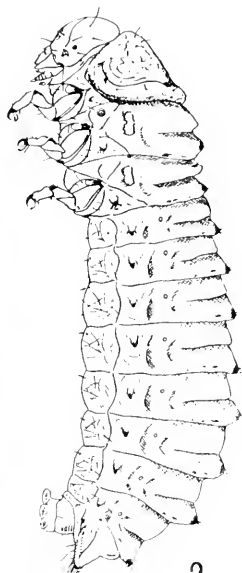
HABITUS OF LARVAE

- FIG. 1. *Monocesta coryli* Say—Third instar. Dorsal view.  
2. *Monocesta coryli* Say—Third instar. Lateral view.  
3. *Trirhabda canadensis* Kirby—Third instar. Dorsal view.  
4. *Galerucella luteola* Müller—Third instar. Dorsal view.  
5. *Galerucella luteola* Müller—Third instar. Ventral view.  
6. *Lochmaca capreae* Linnaeus—First instar. Lateral view.  
7. *Monoaxia puncticollis* Say—Third instar. Lateral view.



1

*Monocesta coryli*

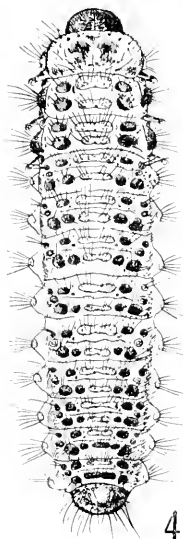


2

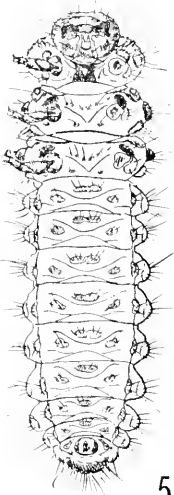


3

*Trirhabda canadensis*



4



5



6



7

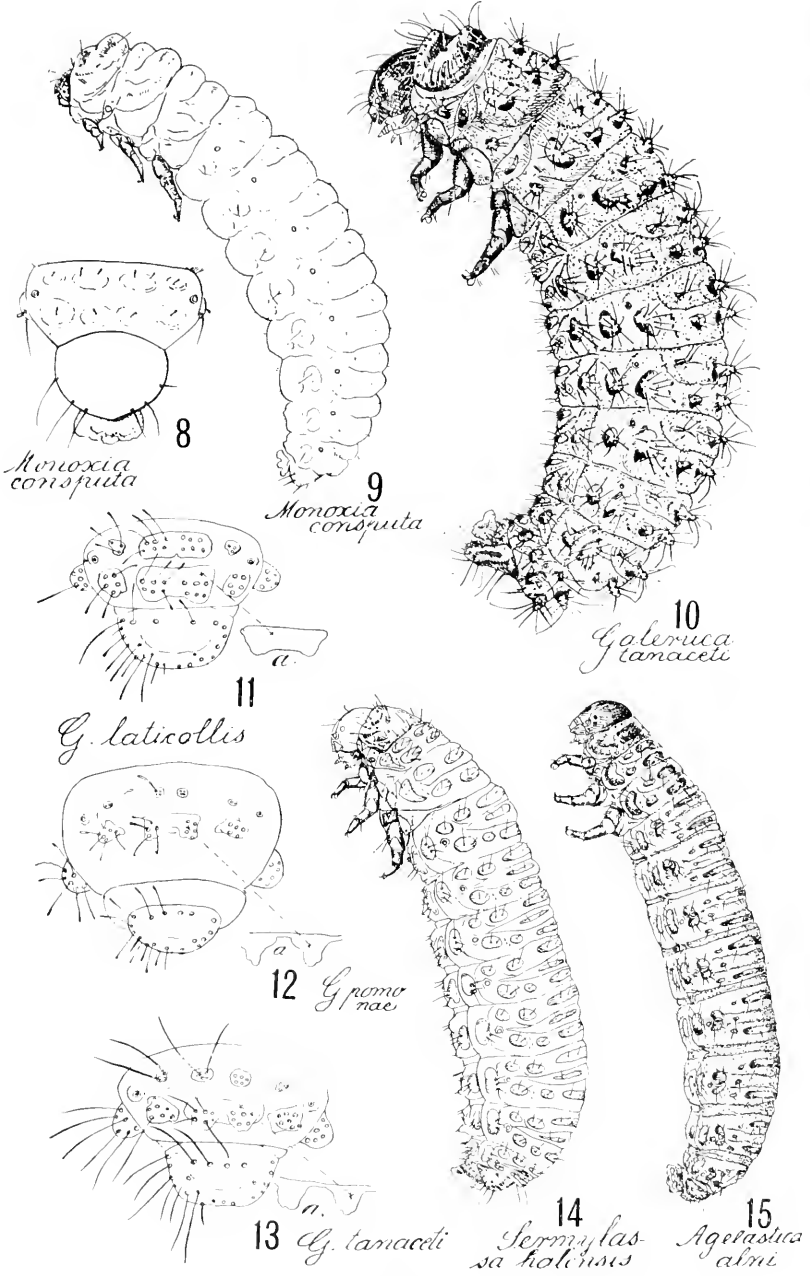
*Galerucella luteola*

*Loemana capreae*

*Monoxia puncticollis*

HABITUS OF LARVAE

FOR EXPLANATION OF PLATE SEE PAGE 41



HABITUS OF LARVAE ENDS OF ABDOMEN

FOR EXPLANATION OF PLATE SEE PAGE 45

PLATE 2

HABITUS OF LARVAE—ENDS OF ABDOMEN

- FIG. 8. *Monoxia consputa* LeConte—The last three abdominal segments of third instar. Dorsal view.
9. *Monoxia consputa* LeConte—Third instar. Lateral view.
10. *Galeruca tanaceti* Linnaeus—Third instar. Lateral view.
11. *Galeruca laticollis* Sahlberg—Eighth and ninth abdominal segments of third instar. Dorsal view.
- 11a. *Galeruca laticollis* Sahlberg—Transverso-vertical section of scutellum.
12. *Galeruca pomonae* Scopoli—Eighth and ninth abdominal segments of third instar. Dorsal view.
- 12a. *Galeruca pomonae* Scopoli—Transverso-vertical section of scutellum.
13. *Galeruca tanaceti* Linnaeus—Eighth and ninth abdominal segments of third instar. Dorsal view.
- 13a. *Galeruca tanaceti* Linnaeus—Transverso-vertical section of scutellum.
14. *Sermylassa halensis* Linnaeus—Third instar. Lateral view.
15. *Agelastica alni* Linnaeus—Third instar. Lateral view.

PLATE 3

DIFFERENT SPECIES OF GALERUCELLA

FIG. 16. *Galerucella nymphaeae* Linnaeus—Labrum.

17. *Galerucella nymphaeae* Linnaeus—Seta.

18. *Galerucella nymphaeae* Linnaeus—Dorsal sclerites of the thoracic and first abdominal segments. Oblique dorsal view. (Parascutal areas stippled.)

19. *Galerucella nymphaeae* Linnaeus—Left mandible. Ventral side.

20. *Galerucella nymphaeae* Linnaeus—Right maxilla. Ventral view. (Notice the three-jointed palpus.)

21. *Galerucella luteola* Müller—Dorsal sclerites of the thoracic and first abdominal segments. Oblique dorsal view. (Parascutal areas stippled.)

22. *Galerucella spiracae* Fall—Dorsal sclerites of the thoracic and first abdominal segments. Oblique dorsal view. (Parascutal areas stippled.)

23. *Galerucella viburni* Paykull—Dorsal sclerite of the thoracic and first abdominal segments. Oblique dorsal view. (Parascutal areas stippled.)

24. *Galerucella notata* Fabricius—Dorsal sclerites of the thoracic and first abdominal segments. Oblique dorsal view. (Parascutal areas stippled.)

25. *Galerucella spiracae* Fall—Left mandible.

26. *Galerucella spiracae* Fall—Seta.

27. *Galerucella viburni* Paykull—Left mandible.

28. *Galerucella viburni* Paykull—Seta.

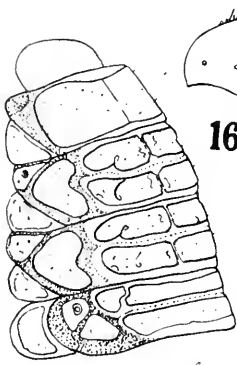
29. *Galerucella notata* Fabricius—Left mandible.

30. *Galerucella notata* Fabricius—Seta.

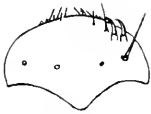
31. *Galerucella spiracae* Fall—Labrum.

32. *Galerucella viburni* Paykull—Labrum.

33. *Galerucella notata* Fabricius—Labrum.



18 nymph.



16 nym.



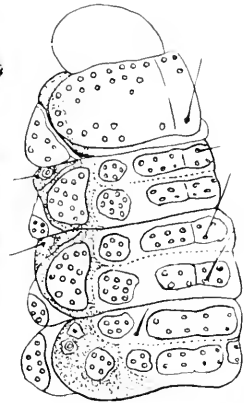
17 nym.



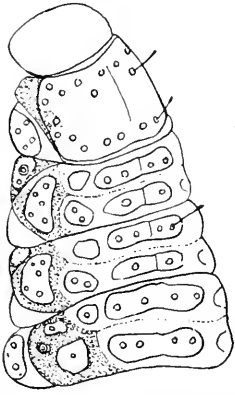
20 nym



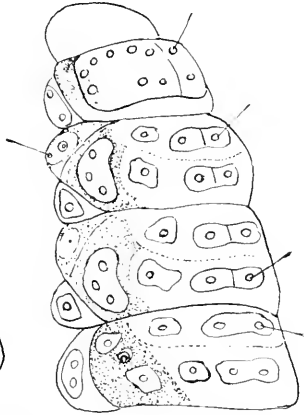
19 nymph.



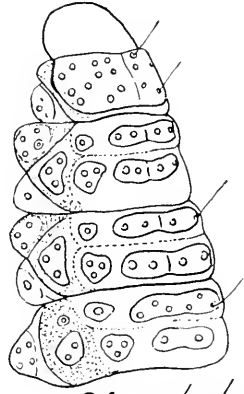
21 luteola



22 spiracae



23 viburni



24 notata



25 spir.



26 spir.



27 vib.



28 vib.



29 nota.



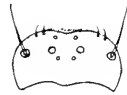
30 nota.



31 spiracae



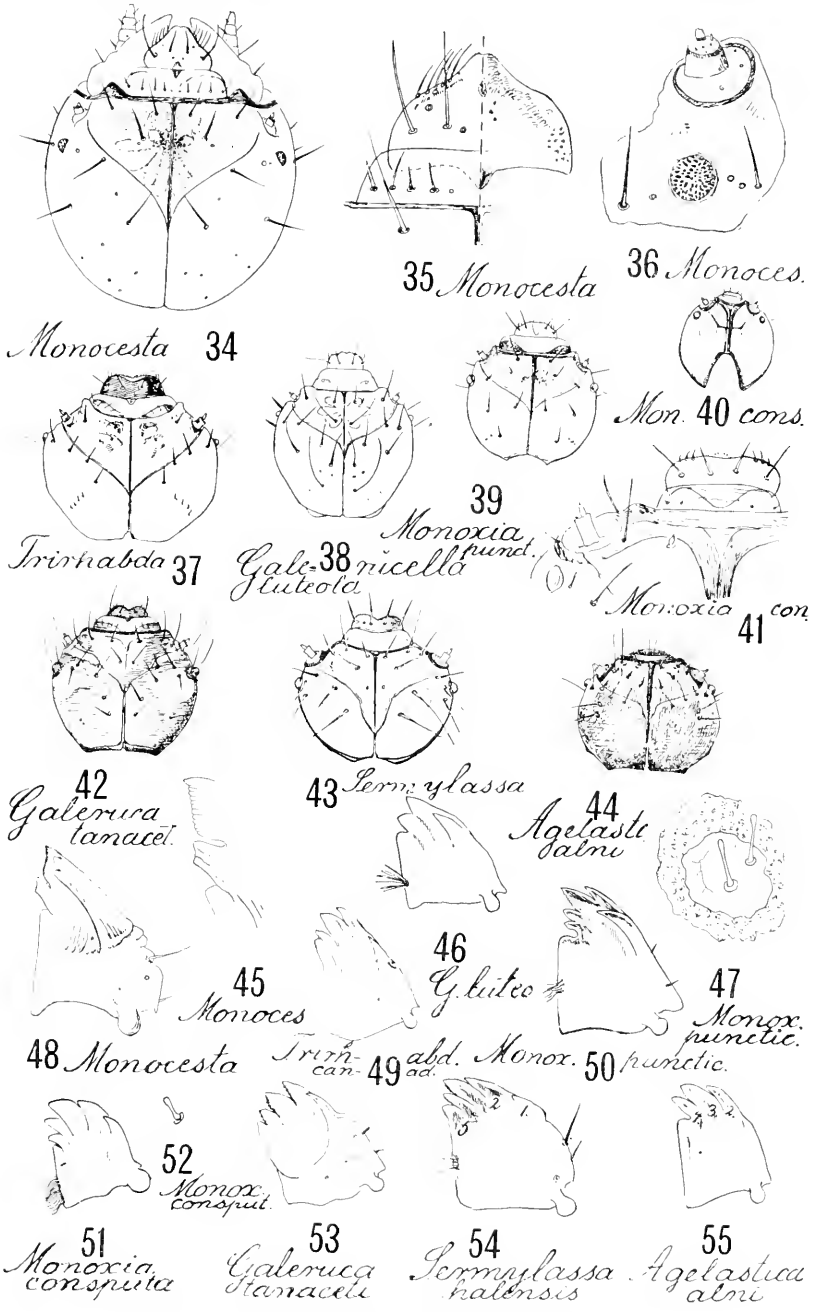
32 viburni



33 notata

DIFFERENT SPECIES OF GALERUCELLA

FOR EXPLANATION OF PLATE SEE PAGE 46



HEADS FROM ABOVE- MANDIBLES, AND OTHER PARTS

FOR EXPLANATION OF PLATE SEE PAGE 47



PLATE 4

HEADS FROM ABOVE—MANDIBLES AND OTHER PARTS

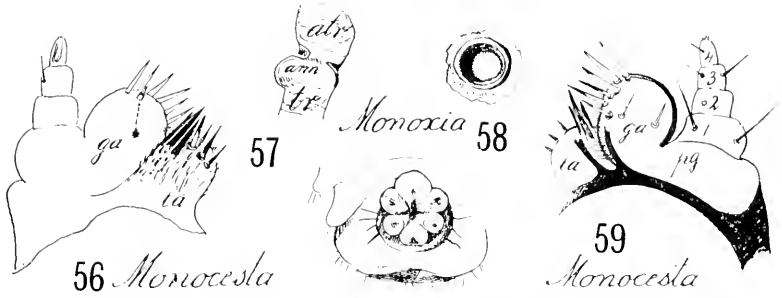
- FIG. 34. *Monocesta coryli* Say—Head. Dorsal view.  
35. *Monocesta coryli* Say—Labrum and clypeus.  
36. *Monocesta coryli* Say—Antenna and ocellus.  
37. *Trirhabda canadensis* Kirby—Head.  
38. *Galerucella luteola* Müller—Head. Dorsal view.  
39. *Monoxia puncticollis* Say—Head. Dorsal view.  
40. *Monoxia consputa* LeConte—Head. Dorsal view.  
41. *Monoxia consputa* LeConte—Labrum, clypeus, epistoma, antenna, and ocellus. Dorsal view.  
42. *Galeruca tanacetii* Linnaeus—Head. Dorsal view.  
43. *Scrymlyssa halensis* Linnaeus.—Head. Dorsal view.  
44. *Agelastica alni* Linnaeus—Head. Dorsal view.  
45. *Monocesta coryli* Say—Tip of left mandible.  
46. *Galerucella luteola* Müller—Left mandible.  
47. *Monoxia puncticollis* Say—Two setae, small sclerite, and piece of dark skin.  
48. *Monocesta coryli* Say—Left mandible.  
49. *Trirhabda canadensis* Kirby—Left mandible.  
50. *Monoxia puncticollis* Say—Left mandible.  
51. *Monoxia consputa* LeConte—Left mandible.  
52. *Monoxia consputa* LeConte—Seta.  
53. *Galeruca tanacetii* Linnaeus—Left mandible.  
54. *Scrymlyssa halensis* Linnaeus—Left mandible.  
55. *Agelastica alni* Linnaeus—Left mandible.

PLATE 5

MAXILLAE, LABIUM, HYPOPHARYNX, AND OTHER PARTS

- FIG. 56. *Monocesta coryli* Say—Buccal side of left maxilla.\*—Tactile papilla of galea; *ga*—galea; *la*—lacinia.
57. *Monoxia consputa* LeConte—Spiracular trachea (*tr*) with one-armed closing apparatus; (*atr.*) atrium.
58. *Monoxia consputa* LeConte—Spiracle.
59. *Monocesta coryli* Say—Left mandible. Ventral view. 1, 2, 3, 4—Four joints of palpus; *pg*—palpiger.
60. *Monocesta coryli* Say—Tenth abdominal segment from below, showing anus in center and six anal lobes.
61. *Monocesta coryli* Say—Labium with ligula, hypopharynx, buccal side of lacinia and galea, maxillary palpus and palpiger (notice that the two muscles from the proximal end of the first joint of the maxillary palpus extend through palpiger and attach themselves to stipes, and that palpiger has no muscles extending from its proximal end); *cu*—culabium; *ga*—galea; *hy*—hypopharynx; *la*—lacinia; *li*—ligula; *mt*—mentum; *pg*—palpiger; *ph*—pharynx; *stip*—stipes.
62. *Monocesta coryli* Say—Leg. *cl*—claw; *cox*—coxa; *fe*—femur; *po*—paronychial appendix; *ti*—tibia; *tr*—trochanter.
- 63a. *Monocesta coryli* Say—Lacinia, galea and hypopharynx facing the buccal cavity.
- 63b. *Monocesta coryli* Say—Galea, mentum, labium with ligula. Ventral view.
64. *Trirhabda nitidicollis* LeConte—Maxillae and hypopharynx; *hr*—hypopharyngeal rod.
65. *Monoxia consputa* LeConte—Maxillae and hypopharynx (notice that maxillary palpus is three-jointed, second and third joints having fused).
66. *Trirhabda canadensis* Kirby—Right maxilla. Ventral view.
67. *Galerucella luteola* Müller—Right maxilla. Ventral view.
68. *Monoxia puncticollis* Say—Right maxilla. Ventral view.
69. *Galeruca tanacetii* Linnaeus—Right maxilla. Ventral view.
70. *Galeruca tanacetii*—Ventral mouthparts and hypopharynx. Ventral view.
71. *Sermylassa halensis* Linnaeus—Right maxilla. Ventral view.
72. *Agclastica albi* Linnaeus—Right maxilla. Ventral view.
73. *Agclastica albi* Linnaeus—Labium (notice the short distance between labial palpi).

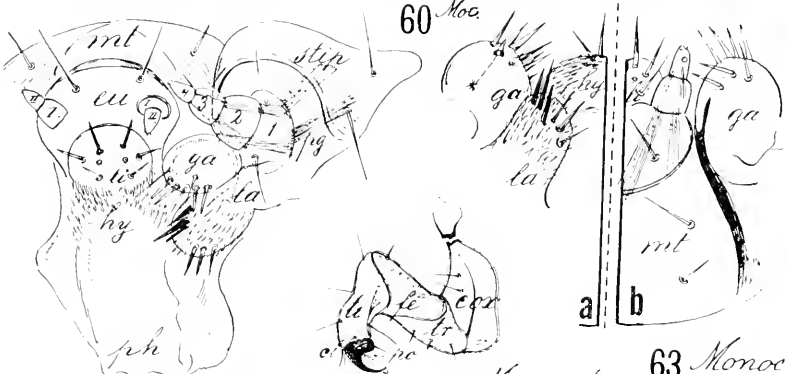




56 *Monocesta*

*Monoxia* 58

59 *Monocesta*

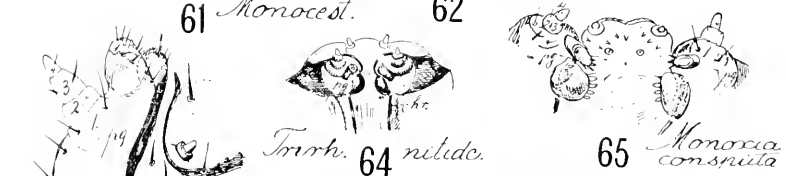


60 *Mon.*

61 *Monocest.*

62 *Monocest.*

63 *Monoc.*



*Triob.* 64 nitide.

65 *Monoxia conspita*

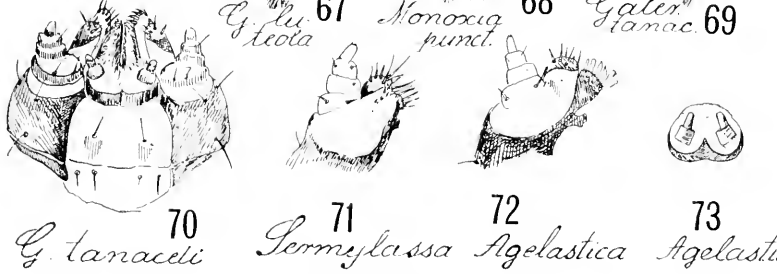


*Triob.* 66 can.

G. tu 67 teola

68 *Monoxia punct.*

69 *Galer tanac.*



70 *G. tanaceti*

71 *Sermylassa*

72 *Agelastica*

73 *Agelastic*

MAXILLAE, LABIUM, HYPOPHARYNX, AND OTHER PARTS



OF SOME NEW AND INTERESTING SPECIES OF WATER  
BEETLES OF THE FAMILY GYRINIDAE IN THE  
UNITED STATES NATIONAL MUSEUM

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By GEORG OCHS

*Of Frankfurt am Main, Germany*

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I have to thank the authorities in charge of the entomological collection of the United States National Museum for permission to work upon the foreign species of Gyrinidae in that Museum.

The material sent me contained several new forms, descriptions of which are given below. There were also represented many other species, already known, which are likewise treated so far as they gave reason for special remarks.

**AULONOGYRUS CONSPICUUS, new species**

Length:  $7\frac{3}{4}$  to  $8\frac{1}{4}$  mm. Oval, hardly elongate, moderately convex. Upper surface dark green, head and prothorax bluish with coppery and purplish reflections, side margin rufous; under surface dark, mesosternum, anal segment and legs rufous, epipleura yellow. Labrum transverse, coppery-green, shining, finely alutaceous, anterior margin with long whitish hairs; clypeus coppery, strongly alutaceous and punctate; head bluish, indistinctly alutaceous, vermiformly wrinkled and punctate, laterally coppery-aceous, purplish and more distinctly alutaceous and punctate near the eyes; prothorax with bluish reflections, indistinctly alutaceous and strongly punctate, in the middle transversely impressed and longitudinally channeled, laterally with a purplish and strongly alutaceous spot, the rufous side margin anteriorly larger than posteriorly; scutellum purplish, shining; suture of elytra coppery, truncature convex with obtuse and scarcely rounded angles, each elytron with ten coppery sulci, which are strongly alutaceous, serially punctured and apically united two and two, the outer ones being more strongly impressed, intervals not distinctly alutaceous, but strongly punctate, the eighth and tenth narrower than the others; anterior tibiae curved inwards, the outer margin apically dilated after the middle of length, apex obliquely truncate, external apical angle obtuse, scarcely produced.

*Type*.—(Cat. No. 41241, U.S.N.M.) from British East Africa: Mount Kenia to Fort Hall (E. A. Mearns coll.) in the United States National Museum; *paratype* in collection of the author.

In size and shape of the body very similar to *A. formosus* Modeer (*-capensis* Authors) and likewise dark colored beneath. Above *A. conspicuus* is more greenish (bluish in *formosus*) and easily to be recognized by the uniform sculpture of the intervals on elytra, none of which is more strongly alutaceous than the others, a character which is unique in the genus.

**GYRINUS ORIENTALIS forma POLITUS, new female form**

While in the typical form the disk of elytra in the female specimens is finely alutaceous, there is no trace of such sculpture in Szechuan specimens. All other characters are like in the typical form, and the males are not different at all.

*Type* and seven *paratypes*.—(Cat. No. 41242, U.S.N.M.) from China, Szechuan near Kiating, Shin-Kai-Si, Mount Omei, 4400 feet (D. C. Graham 1921) in the United States National Museum; three *paratypes* in collection of the author.

The typical form is represented in the same collection from China, Kiangsi Prov., Kuling near Kiu-Kiang, near Yellow Dragon Temple, October 16, 1919 (H. F. Loomis). I have seen other specimens from: Soochow, March 25, 1923 (Suenson coll., Coll. Ochs); Shanghai (Mus. Stettin); Foochow (Cons. Siemens coll. 1907, Mus. Bremen); Hongkong, 1876 (Coll. Ochs); Pingshiang (Dr. Kreyenberg coll., Coll. Ochs); Northern Kuangtung, Tsha-jiu-san 1400 m. May-June, 1912 (Mell coll., Coll. Ochs); Yünnan-fu, San-Non-Kai (Coll. Ochs); S. E. Yunnan, Kuang-Si-Hien 2100 m. (Coll. Ochs).

**GYRINUS JAPONICUS forma FRANCKI, new female form**

As with the preceding species there exists also a female form of *G. japonicus* of probably local distribution with polished elytra, as in the males. In the typical female the disk of the elytra is very strongly alutaceous.

The *type*, a single specimen, was presented to me by Dr. P. Franck of Hamburg, in whose honor the new form is named, and is labeled: East Asia, Vladivostok (Hermann Frieb coll.) In all other characters it agrees with specimens of *G. japonicus* from different Japanese localities which are in my collection.

**GYRINUS NATATOR subspecies SZECHUANENSIS, new subspecies**

Shape of the body and the color of under surface as in *G. natator substriatus*: rather broadly oval, mesosternum dull rufous, anal segment and epipleura bright red. The serial punctures in elytra sim-

ilar to those in *G. natator natator*, evident to the suture and not very strongly impressed outwards. The convexity of body is very strong, the pronotum is relatively long and with only slight impressions.

*Type*.—Female (Cat. No. 41243, U.S.N.M.) from China, Szechuan, Kuanshien August 19, 1924, 13,000 feet altitude (D. C. Graham), in the United States National Museum. There is another female from Szechuan between Chengtu and Kuanshien, July 2-5, 1924 (D. C. Graham), which exhibits the same characters.

#### GYRINUS RUGIFER, Régimbart

*Gyrinus rugifer* RÉGIMBART, 1883, Ann. Soc. Ent. France, ser. 6, vol. 3, p. 179.—FLEUTIAUX and SALLÉ, 1889, Ann. Soc. Ent. France, ser. 6, vol. 9, p. 374.—RÉGIMBART, 1907, Ann. Soc. Ent. France, vol. 76, p. 180.—OCHS, 1924, Amer. Mus. Nov., No. 125, p. 3.

Specimens in the United States National Museum from Haiti, Le Trou, September, 1925 (Hoffman). Hitherto only known from Guadeloupe, Dominica, and Porto Rico.

#### GYRINUS COLOMBICUS Régimbart

*Gyrinus colombicus* RÉGIMBART, 1883, Ann. Soc. Ent. France, ser. 6, vol. 3, p. 180; 1907, Ann. Soc. Ent. France vol. 76, p. 178.

Specimens from Bolivia, Limon, September, 1923 (Harrington), in the United States National Museum agree very well with Régimbart's description. The species was mentioned by the describer from Colombia and Venezuela. I have seen, besides the above mentioned, only a few specimens from Colombia (Coll. Sharp, in the British Museum) and from Bogota (Coll. Klages, in the Carnegie Museum), which can probably be referred to that species.

#### GYRETES BOUCARDI Sharp

*Gyretes boucardi* SHARP, 1882, Biol. Centr. Amer., Col., vol. 1, pt. 2, p. 51.—RÉGIMBART, 1883, Ann. Soc. Ent. France, ser. 6, vol. 3, p. 407; 1907, Ann. Soc. Ent. France, vol. 76, p. 188.

In the females the hairless part of elytra is generally strongly alutaceous, although polished specimens were mentioned by Régimbart in 1907,<sup>1</sup> as variety *dimorphogynus*.

Of the latter I had only seen a single specimen from Guatemala (from Coll. Donckier, Peschet leg., now in my collection). The United States National Museum possesses another specimen of this kind from Mexico, Tapachula, May, 1923 (W. M. Mann).

These are very similar to *Gyretes mexicanus* Régimbart, but may easily be distinguished by the exterior apical angle of elytra, which is obtuse in *mexicanus*, angular in *dimorphogynus*; moreover the

<sup>1</sup> Ann. Soc. Ent. France, vol. 76, p. 188.

tomentous border of elytra is dilated suddenly shortly before the apex in *dimorphogynus*, while it is gradually broadened in *mexicanus*.

GYRETES MINOR Régimbart

*Gyretes lionotus* SHARP (ex. p.) 1882, Biol. Centr. Amer., Col., vol. 1, pt. 2, p. 50.

*Gyretes minor* RÉGIMBART 1883, Ann. Soc. Ent. France, ser. 6, vol. 3, p. 407, pl. 11, figs. 114, 114a.—SHARP 1887 (?), Biol. Centr. Amer., Col., vol. 1, pt. 2, Suppl., p. 761.

Described from Guatemala, Torola (Champion). I have seen a good series in the Hamburg Museum for Guatemala, Hacienda Trapiche Grande near Cuyotenango (Riedel collector, Dr. G. v. Sydow leg.). The United States National Museum possesses numerous specimens from Mexico, Cordoba, Vera Cruz, April 17, 1908 (Fr. Knab coll.) comprising 34 males and only three females, which exhibit the strongly alutaceous surface of elytra, which was indicated by the describer of the species.

GYRETES MINOR forma LAEVIPENNIS, new female form

Other females of the same series have the hairless parts of elytra polished like the males, from which they are easily distinguished by the narrow anterior tarsi; moreover the tomentous border of elytra is apically more enlarged in these females.

*Type* and six *paratypes* (Cat. No. 41244, U.S.N.M.) in the United States National Museum, three *paratypes* in collection of the author.

GYRETES GUATEMALENSIS Régimbart

*Gyretes levis* SHARP 1882, Biol. Centr. Amer., Col., vol. I, pt. 2, p. 51 (err. det.)

*Gyretes guatemalensis* RÉGIMBART 1883, Ann. Soc. Ent. France, ser. 6, vol. 3, p. 399.—SHARP 1887 (?), Biol. Centr. Amer., Col., vol. 1, pt. 2 Suppl., p. 761.—ZIMMERMAN 1917, Ent. Mitt., vol. 6, p. 164.

Panama: Ancon, C. Z., May 17, 1911, electric light (A. H. Jennings), one specimen female in the United States National Museum.

ORECTOCHILUS OBSCURICEPS Régimbart

*Orectochilus obscuriceps* RÉGIMBART 1907, Ann. Soc. Ent. France, vol. 76, p. 215.

Described from Central China, Szechuan, Siao-Lou (Coll. Oberthür and Régimbart). The United States National Museum possesses three specimens from Manchuria and Korea: Yalu River 150-200 miles from mouth, May, 1914 (A. D. C. Sowerby), which agree very well with Régimbart's description and may probably be referred to that species. As, however, I do not possess authentic specimens of the latter, I can not decide the question with certainty.



## ORECTOGYRUS ALLUAUDI Régimbart

*Orectogyrus alluaudi* RÉGIMBART 1899, Ann. Soc. Ent. France, ser. 6, vol. 9, p. 250; 1891, Ann. Soc. Ent. France, vol. 60, p. 733, pl. 19, fig. 27; 1895, Mem. Soc. Ent. de Belgique, vol. 4, p. 236; 1902, Ent. Tidskr., vol. 23, p. 299.—OCHS 1926, Ann. Mus. Civ. Genova, vol. 52, p. 168.

Described from the Ivory Coast, collected moreover in Liberia, Upper Senegal, Cameroon, Upper Congo, Eritrea, and N. E. Rhodesia in several varietal forms. The United States National Museum has a series from Liberia: Mount Coffee February, 1897 (R. P. Currie), where the insect was collected together with *Orectogyrus sexualis* and *specularis*.

I have recently seen a single male specimen in the Hamburg Museum from Mecutine, about 70 kilometers west of coast of Mozambique, November 10, 1926, which is exceptionally dark colored, with whitish pubescence, and exhibits no trace of the triangular yellow spot which is generally present at the side margin of pronotum.

## ORECTOGYRUS DISTINCTUS Régimbart

*Orectogyrus schistaceus* RÉGIMBART 1883, Ann. Soc. Ent. France, ser. 6, vol. 3, p. 457, pl. 14, fig. 163 (err. det.).

*Orectogyrus distinctus* RÉGIMBART 1886, Ann. Soc. Ent. France, ser. 6, vol. 3, p. 267; 1895, Mem. Soc. Ent. de Belgique, vol. 4, p. 234; 1907, Ann. Soc. Ent. France, vol. 76, p. 242; 1908, Wiss. Erg. Schwed. Deutsch Ost Afrik. Exp., vol. 7, pt. 1, p. 8.—PESCHET, 1921, Voy. Babault, p. 22, pl. 2, fig. 6.—OCHS 1924, Ent. Blatter, vol. 20, p. 240.

(?) *Orectogyrus suturalis* ZIMMERMAN, 1917, Ent. Mitt., vol. 6, p. 170.

*Type locality*.—Usambara. Known from many localities in British East Africa and Tanganyika-Territory, and moreover collected in Nyassaland. Since my last publication in 1924 I have seen specimens from British East Africa: Kibvezi (Scheffler, in coll. Ochs); Kathini, Limuru, March 5, 1918 (T. J. Andersson, British Museum). Tanganyika-Territory: Kumburu (Museum Hamburg); East Usambara, January, 1909 and December, 1915, Sakaru, September, 1902, Moa, April 1904 (Methner coll.).

The United States National Museum has numerous specimens from British East Africa: Mount Kenia to Fort Hall, 8,300 feet, and Wambugu (E. A. Mearns coll.), most of which exhibit very nice bluish reflections on the smooth parts of the upper surface.

## ORECTOGYRUS CUPRIFER Régimbart

*Orectogyrus cuprifer* RÉGIMBART 1883, Ann. Soc. Ent. France, ser. 6, vol. 3, p. 462; 1895, Ann. Mus. Civ. Genova, ser. 2, vol. 15, p. 194; 1895, Mem. Soc. Ent. de Belgique, vol. 4, p. 234.—OCHS, 1924, Ent. Blatter, vol. 20, p. 240; 1925, vol. 21, p. 184; 1926, Ann. Mus. Civ. Genova, vol. 52, p. 171.

The United States National Museum has several from Lourenço Marquez: Mahota, June 6, 1909 (from C. W. Howard), which is the

most southern locality hitherto recorded for that species, which is widely dispersed in Africa and ranges from the Gold Coast to Angola in the west and from Somaliland southwards in the east.

The Hamburg Museum possesses two male specimens from Mecutine, about 70 kilometers west of the coast of Mozambique November 10, 1926, which are nearly uniformly black colored above and have exceptionally short discal ridges.







# A REVIEW OF THE BIRDS OF THE ISLANDS OF SIBERUT AND SIPORA, MENTAWI GROUP<sup>1</sup> (SPOLIA MENTAWIENSIA)

By J. H. RILEY

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Off the west coast of Sumatra lies a long chain of islands of varying size, stretching from Simalur in the north to Engano in the south, a distance of over 700 miles. Dr. W. L. Abbott became interested in this chain and in the autumn of 1901 visited Simalur, Pulo Babi, Pulo Lasia, and the Banjak Islands, making collections on each of them. The bird material of this collection was worked up by Dr. Charles W. Richmond, who published an account of it.<sup>2</sup> In the autumn of 1902, Doctor Abbott, accompanied by Mr. C. Boden Kloss, revisited Simalur, and then went to the Pagi and Batu Islands, and Nias, the latter already known ornithologically from Modigliani's explorations; in the autumn of 1904 he visited Engano, and early in 1905 returned to Nias. Dr. H. C. Oberholser<sup>3</sup> has published an account of the second Abbott collection from Simalur, but the collections from the other islands never have been reported upon as a whole, though Oberholser has described many new forms from them, in one paper<sup>4</sup> no less than 97, with scattered descriptions at subsequent dates. In this early paper the descriptions are very brief and are unaccompanied by measurements or information concerning the number of specimens upon which his conclusions were based. For this reason it is utterly impossible for any subsequent worker to reach any definite conclusions with material from adjacent islands without consulting toponymical material.

<sup>1</sup>The present paper is one of a series under the general heading of "Spolia Mentawiensia," dealing with collections in natural history made in 1924 in the Mentawi Islands by Mr. C. Boden Kloss and his assistants of the Raffles Museum in Singapore. The National Museum is indebted to the friendly cooperation of Dr. W. L. Abbott for a share in the material secured during this work.

<sup>2</sup>Proc. U. S. Nat. Mus., vol. 26, 1903, pp. 485-524.

<sup>3</sup>Idem, vol. 55, 1919, pp. 473-498.

<sup>4</sup>Smiths. Misc. Coll., vol. 60, no. 7, 1912, pp. 1-22.

At the time Doctor Abbott was active in this region, he was unable to get permission from the Dutch authorities to visit Siberut and Sipora, two islands of fair size lying north of the Pagi Islands, and with them constituting the Mentawi Group.

When, in the autumn of 1924, Mr. Kloss and a party from the Raffles Museum, Singapore, visited Siberut and Sipora to make a general natural history survey, Doctor Abbott contributed funds in aid of the enterprise, in return for which support the United States National Museum was to receive a set of the duplicates.

After writing an account of the birds, in conjunction with Mr. F. N. Chasen,<sup>5</sup> Mr. Kloss, the Director of the Raffles Museum, forwarded the whole collection to Washington, with the exception of certain specimens which he took to London for further study, and requested the writer to prepare a review of the collection after making comparisons with related material in Doctor Abbott's collections from neighboring islands.

A report upon the avifauna of the whole chain of islands off the west coast of Sumatra would be welcome, but the writer does not wish to anticipate the results of Doctor Oberholser, who has been engaged upon the birds of this general region for so many years. For this reason he has confined himself to the Mentawi Group alone, more particularly to Siberut and Sipora, and has mentioned related forms from other islands only when in his opinion this would lead to a better understanding of the Mentawi birds.

Chasen and Kloss, in their paper (cited above), named 11 new subspecies from Siberut and Sipora, three of which are not recognized in the present paper, but the writer<sup>6</sup> has described three additional ones which are believed to be valid. Two of these are from Siberut and Sipora, the other from Sipora and the Batu Islands. This arrangement leaves 10 forms confined to the two northern islands, but in the Mentawi Group as a whole there are 32 peculiar forms.

The islands off the west coast of Sumatra generally are closely related in their avifauna to the mainland and Sumatra, as would naturally be expected, with a few well-differentiated species and many more or less well-marked races. As a rule, the forms from Simalur seem to be more strongly characterized than those from the remainder of the chain, with the possible exception of Engano.

Messrs. Chasen and Kloss are to be congratulated upon their successful trip and on their published ornithological results; their paper has left very little to be supplied here that is additional or new.

<sup>5</sup> *Ibis*, 1926, pp. 269-306.

<sup>6</sup> *Proc. Biol. Soc. Washington*, vol. 40, 1927, pp. 95, 96.

For an account of the physical features of Siberut and Sipora and other details the reader is referred to the "Ibis" paper mentioned above.

#### ANNOTATED LIST OF SPECIES

##### TRERON CURVIROSTRA SMICRA Oberholser

*Treron curvirostra smicra* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 3 (Tana Bala Island, Batu Islands).

*Treron curvirostra* CHASEN and KLOSS, Ibis, 1926, p. 273.

Two males and one female, Sipora; six males and two females, Siberut.

The Sipora and Siberut birds, compared with *T. c. hypothapsina* of Engano, have the greens above and below much more yellowish, with the yellow on the greater wing coverts brighter.

The type of *Treron curvirostra smicra* of the Batu Islands is an immature male not in full plumage (the describer evidently had only the one specimen); it is brighter and more yellowish than the Engano bird, but not as yellowish below as the adult males from Sipora and Siberut. It approaches the female from Sipora and Siberut in color of the underparts; the head is washed with greenish, but is becoming gray. It would be unsafe to separate the Sipora-Siberut birds until we know what the adult of typical *smicra* is like.

*Treron curvirostra pega* of Nias is quite distinct, very pale below, greenish glaucous, washed on the chest with light grape green with a buffy tinge, and without the yellowish tinge on chest as in *smicra*; there are also other differences. The female is without the buffy tinge on the chest, which is darker.

*Treron curvirostra haliploa* of Simalur resembles *pega*, but is darker below and the chest is washed with grape green, without buffy tinge. This form was evidently based on a single specimen.

There thus appear to be four races of this species on the islands off the west coast of Sumatra, as below:

*Treron curvirostra hypothapsina*<sup>7</sup> from Engano.

*Treron curvirostra smicra*,<sup>8</sup> from Sipora, Siberut, and the Batu Islands.

*Treron curvirostra pega*<sup>8</sup> from Nias.

*Treron curvirostra haliploa*<sup>8</sup> from Simalur.

##### DENDROPHASSA VERNANS MESOCHLOA Oberholser

*Dendrophassa vernans mesochloa* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 2 (Nias Island).

*Treron vernans* CHASEN and KLOSS, Ibis, 1926, p. 274.

Two males, Sipora; one male and one female, Siberut.

<sup>7</sup> Oberholser, Smiths. Misc. Colls., vol. 60, no. 7, 1912, p. 3.

<sup>8</sup> Idem, p. 4.

The specimens from Siberut and Sipora are intermediate between the Nias form and that from the Pagi Islands, but on the whole nearer to that of Nias.

Considering only those forms of the species described from the Sumatran west coast islands, we have:

*Dendrophassa vernans mesochloa*,<sup>9</sup> from Nias.

*Dendrophassa vernans polioptila*,<sup>9</sup> from North Pagi.

*Dendrophassa vernans miza*,<sup>9</sup> from Simalur.

The males of *D. v. miza* are more greenish on the back and are larger than the Nias bird. The wings of the males measure: 166, 163, 160.5 mm., and of the female (type), 156 mm. The culmen (from cere) is also longer; in males, 12, 12.5, 11.5; in the female 11 mm.

The male of the Nias form is not so deep a green on the back and is smaller than the Simalur bird. Males measure, wing, 148.5, 157, 154, 151, 151.5, 151, 154.5, 154 mm.; culmen (from cere), 10-11.5 mm. Females, wing, 152 (type), 148, 148; culmen (from cere), 10-10.5 mm.

One male from Siberut measures, wing, 161; one female, 147.5 mm.

Two males from Sipora have the wings 153 and 156 mm.

A male from Tana Bala, Batu Islands, is here assigned to the Nias form, with wing 149; culmen from cere, 11 mm.

Males from the Pagi Islands are slightly lighter below than those from Nias, and this slight difference also holds in the females. There appears to be little or no difference in size, however. The wings of males measure: North Pagi Island, 148, 151.5, 161, 162.5 mm.; culmen, from cere, 11-11.5 mm. Females from the same island have the wing 154.5, 155, 157.5, 155, 150 (type of *polioptila*); culmen, from cere, 10-11 mm. Males from South Pagi Island have the wing 146, 149; culmen from cere, 10-11 mm.

A male from Engano is like the Nias bird; it measures, wing, 157; culmen, from cere, 11.5 mm.

The color differences between Pagi and Nias birds are only average and not constant; some of the Pagi males can not be distinguished from those of Nias. The differences between the females seem to be more constant, but there are only three females in the Nias series, and they were taken later in the season.

The single female from Siberut is greener below, with the yellow on the belly more restricted than in any specimen before me, and the under tail coverts are very light, with a mere indication of chestnut along the basal part of the shaft. The latter character is very variable and there are others in the series just as light or more so.

It seems to me that no great violence would be done if *polioptila* were united to *mesochloa*, in which case only two forms would

<sup>9</sup> Oberholser, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 3.



be recognized from the islands off the west coast of Sumatra, as follows:

1. *Dendrophassa vernans miza*, confined, as far as known, to Simalur; the males larger and more greenish below.

2. *Dendrophassa vernans mesochloa*, extending from Nias to and including Engano; the males smaller and more yellowish below. *D. v. polioptila* becomes a synonym of this.

#### MUSCADIVORES AENEUS VICINUS Riley

*Muscadivores aeneus vicinus* RILEY, Proc. Biol. Soc. Washington, vol. 40, 1927, p. 95 (Sipora Island).

*Ducula aenea* CHASEN and KLOSS, Ibis, 1926, p. 274.

One male, seven females, and one unsexed bird from Siberut; six males and two females from Sipora.

The series submitted from the two islands seem to be alike, as Chasen and Kloss have remarked, and it only remains to compare them with specimens from the other islands. *Muscadivores aeneothorax* of Engano, on account of its differently colored under tail coverts and other features, is so distinct that it need not be considered further in this connection. Specimens from Simalur south to the Pagi Islands are quite similar in color and only differ slightly in degree or in size. Nias birds have very little vinaceous wash on the breast, in certain lights not evident at all; it has been named *Carpophaga consobrina* Salvadori.<sup>10</sup> Birds from Pulo Babi and Pulo Lasia have been separated from *consobrina* on larger size. They appear also to be slightly more vinaceous on the breast and hind neck and have been named *Muscadivores consobrina babiensis* Richmond.<sup>11</sup> Simalur birds have been separated on size from *consobrina*, as decidedly smaller, and the measurements show that they are somewhat so. There is apparently little or no difference in color. They have been named *Muscadivores aeneus mistus*<sup>12</sup> Oberholser. The Siberut-Sipora series is a puzzle. The breasts of these birds are washed with deeper vinaceous; in one or more specimens the nape and hind neck is deep purplish vinaceous; in others the breast is vinaceous lilac, the head and nape gray like *consobrina* from Nias; in other specimens the vinaceous wash on the breast is not so pronounced. The specimen with the most pronounced deep purplish vinaceous nape and vinaceous lilac breast agrees with the description of *Carpophaga vandepolli* Büttikofer.<sup>13</sup> except for some minor details. If all the vinaceous-naped, vinaceous-breasted birds were similar, one would be inclined to believe two species were involved, but

<sup>10</sup> Ann. Mus. Civ. Genova, ser. 2, vol. 4, 1887, p. 558.

<sup>11</sup> Proc. Biol. Soc. Washington, vol. 25, 1912, p. 103.

<sup>12</sup> Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 2.

<sup>13</sup> Notes Leyden Mus., vol. 17, 1896, p. 190.

there is a perfect gradation from the darkest naped and breasted bird to the gray-naped and almost gray-breasted one. Regardless of whether the nape is vinaceous or gray, the series averages more vinaceous on the breast and nape than *consobrina* from Nias. A series from North and South Pagi contains none of the deep vinaceous naped or breasted birds; it averages, however, more vinaceous on the hind neck and breast than *consobrina* from Nias. Two males from Tana Bala, Batu Islands, are like those from the Pagi Islands. I am inclined to think there are two phases of *consobrina* occurring on Nias, corresponding to the vinaceous naped and breasted bird on Sipora and Siberut, and that the Mentawi-Batu bird is a variable form distinct from *consobrina*.

Summarizing, I will either have to unite all the birds from the islands off the west coast of Sumatra, except Engano, under one name, or recognize a number of forms. The differences between the forms is admittedly slight, but it seems better to recognize them rather than merge them into one variable race. This being the case, I think, considering the material before me, that the following forms can be made out:

1. *Muscadivores aeneus mistus* Oberholser (Simalur Island). Six males measure: Wing, 226-240 (229) mm.; five females, wing, 215-225 (222) mm.

2. *Muscadivores aeneus babiensis* Richmond (Pulo Babi and Pulo Lasia). Three males measure: Wing, 237-246 (243) mm.; two females, wing, 232-238 (235) mm.

3. *Muscadivores aeneus consobrinus* (Salvadori) (Nias). Eight males measure: Wing, 229-244 (236) mm.; two females, wing, 231-241 (236) mm. A male and a female from Pulo Tuanku, Banjak Islands, I am inclined to place here. The male has a wing 234 mm., and the female 232 mm.

4. *Muscadivores aeneus vicinus* Riley. (Batu and Mentawi Islands). The wings of the males from the various islands represented measure as follows:

Two, Tana Bala, Batu Islands, 227-232 (229.5 mm.).

One, Siberut, 234 mm.

Five, Sipora, 224-240 (231.5 mm.).

Five, North Pagi, 215-245 (231 mm.).

Six, South Pagi, 222-246 (228 mm.).

The wings of the females:

Seven, Siberut, 211-234 (226 mm.).

Two, Sipora, 230-232 (231 mm.).

Three, North Pagi, 220-228 (226 mm.).

Four, South Pagi, 218-228 (222 mm.).

**MYRISTICIVORA BICOLOR BICOLOR (Scopoli)**

*Columba (bicolor)* SCOPOLI, Del. Flor. Faun. Insub., vol. 2, 1786, p. 94, (New Guinea).

*Myristicivora bicolor* CHASEN and KLOSS, Ibis, 1926, p. 275.

Ten males and three females, Sipora.

The United States National Museum also has it from Simalur, Pulo Babi, and Engano.

**MACROPYGIA EMILIANA ELASSA Oberholser**

*Macropygia emiliana elassa* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 2 (Sikakap Strait, North Pagi Id.).

*Macropygia phasianella* CHASEN and KLOSS, Ibis, 1926, p. 275.

Eight males and 7 females, Siberut; 10 males and 9 females, Sipora.

The series secured on Siberut and Sipora is a very fine one, much larger than any series available from any of the neighboring islands. Comparing the females first, as the series of this sex available is more complete from the adjacent islands, it is to be remarked there is considerable variation both in measurements and color in specimens from the same locality. In some the tail is quite dark and the feathers broad while in others the tail is lighter and rusty and the feathers narrower. The specimens with rusty tails have the light bars on the mantle yellowish buff, while in the dark-tailed birds these bars are rusty. All indications are that the light or rusty-tailed specimens are younger birds. Comparing birds of the same age from Siberut with those from Sipora there appear to be no constant differences in color and apparently none in size.

The specimens from the Pagi Islands are similar in color to those from Sipora. The series measured averages slightly smaller in the wing, however, but the measurements overlap and for the present, in my opinion, it is best to consider the Siberut, Sipora, and Pagi Islands birds as belonging to the same form.

Three females from Nias are more rusty on the back and tail, and the black marking on the jugulum is barely indicated or entirely absent; they average larger than Siberut females.

One specimen, unsexed but almost certainly a female, from Simalur, the type of *Macropygia emiliana hypoperena* Oberholser<sup>14</sup> is a deeper brown below with the feathers of the wings more heavily margined with lighter and rustier brown, and it is smaller than the Nias bird. The males as far as they go bear out the above remarks.

<sup>14</sup> Smiths. Misc. Coll., vol. 60, no. 7, p. 2.

From the above, in my opinion, we can recognize three forms at present from the islands off the west coast of Sumatra, as follows:

(1) *Macropygia emiliana hypoperca* Oberholser, confined to Simalur Island;

(2) *Macropygia emiliana modiglianii* Salvadori, confined to Nias Island; and

(3) *Macropygia emiliana classa* Oberholser, from Siberut, Sipora, North and South Pagi Islands. No specimens have been available from Engano.

The measurements (in millimeters) of the specimens from the different islands are as follows:

|                                      | Wing        | Tail        | Culmen      |
|--------------------------------------|-------------|-------------|-------------|
| Eight males from Siberut.....        | 168. 5-191  | 155. 5-177  | 9-11        |
| Ten males from Sipora.....           | 177 -191    | 166 -183. 5 | 10-11. 5    |
| Two males from the Pagi Islands..... | 173 -184    | 161. 5-170  | 10-10. 5    |
| One male from Nias.....              | 181         | -----       | 11          |
| Six females, Siberut.....            | 170 -184    | 166 -174    | 10-11       |
| Seven females, Sipora.....           | 174. 5-187  | 153 -176    | 9. 5-12     |
| Five females, Pagi Islands.....      | 170 -176    | 161 -179    | 10. 5-11    |
| Three females, Nias.....             | 185 -187. 5 | 152 -178    | 10. 5-11. 5 |
| One (female?), Simalur.....          | 174         | 173         | 11. 5       |

#### CHALCOPHAPS INDICA INDICA (Linnaeus)

*Columba indica* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 164 (*India orientali*).

*Chalcophaps indica indica* CHASEN and KLOSS, Ibis, 1926, p. 275.

One female, Siberut Island; the United States National Museum also has an immature female from North Pagi Island.

#### RALLINA FASCIATA (Raffles)

*Rallus fasciatus* RAFFLES, Trans. Linn. Soc. London, vol. 13, 1922, p. 328 (Sumatra).

*Rallina fasciata* CHASEN and KLOSS, Ibis, 1926, p. 276.

One male, Sipora.

The one male taken on Sipora does not seem to differ in size or color from specimens from other parts of the specific range. The Museum also contains a male from Engano Island; rather more hazel above and heavier barred below than usual, but it can be matched by a male from Trong, Lower Siam, so the differences are doubtless individual.

#### AMAURORNIS PHOENICURA CLEPTEA Oberholser

*Amaurornis phoenicura clepatea* OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, 1912, p. 2 (Mojeia River, Nias Island).

*Amaurornis phoenicura javanica* CHASEN and KLOSS, Ibis, 1916, p. 276.

One male, Siberut; three adult males, one immature male, and four females, Sipora.

The specimens from Siberut and Sipora, apparently do not differ from birds from Nias and Simalur. The pure white of the lower abdomen and anal region given by the describer as one of the characters of this race does not hold, specimens with these parts as described and others having them tinged more or less strongly with isabella color occurring in the above series. The race can be maintained, however, as a sort of intermediate between *chinensis* and *javanica*; smaller than the former and somewhat larger than the latter.

In my report upon a collection of birds from Celebes<sup>15</sup> in commenting upon this race I made a slip of the pen in saying *A. p. cleptea* is smaller than *A. p. javanica*; it is actually larger. Since that paper was written the National Museum has received a number of specimens of the Chinese race; all large birds.

**ARENARIA INTERPRES INTERPRES (Linnaeus)**

*Tringa interpres* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 148 (Islands of Gothland, Sweden).

*Arenaria interpres interpres* CHASEN and KLOSS, Ibis, 1926, p. 276.

One female, Sipora, October 24.

**PLUVIALIS DOMINICUS FULVUS (Gmelin)**

*Charadrius fulvus* GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 687 (Tahiti).

*Charadrius apricarius fulvus* CHASEN and KLOSS, Ibis, 1926, p. 276.

Two males and two females, Siberut, September 14–20; one male and one female, Sipora, October 27 and 29.

**CHARADRIUS LESCHENAUThII Lesson**

*Charadrius leschenaultii* LESSON, Dict. Sci. Nat. (Levrault), vol. 42, 1826, p. 36 (Pondichery, India).

*Charadrius leschenaulti* CHASEN and KLOSS, Ibis, 1926, p. 276.

One unsexed, Sipora, October 27.

**NUMENIUS PHAEOPUS PHAEOPUS (Linnaeus)**

*Scelopax phaeopus* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 146 (Sweden).

*Numenius phaeopus* CHASEN and KLOSS, Ibis, 1926, p. 276.

One female, Siberut, September 12; one male, Sipora, November 5.

These two specimens have the white rumps of *N. p. phaeopus*, but seem to have longer bills; it is possible there are more than two forms of the species.

The culmen of the male measures 85; the female, 95 mm.

<sup>15</sup> Proc. U. S. Nat. Mus., vol. 64, art. 16, 1924, p. 22.

## CAPELLA STENURA (Bonaparte)

*Scelopar stenura* BONAPARTE Ann. Stor. Nat. Bologna, vol. 4, 1830, p. 335 (Sunda Islands).

*Capella stenura* CHASEN and KLOSS, Ibis, 1926, p. 277.

One male, Sipora, October 23.

## GLAREOLA MALDIVARUM Forster

*Glareola (Pratincola) maldivarum* FORSTER. Faunula Indica, 1795, p. 11 (Maldive Islands).

*Glareola maldivarum* CHASEN and KLOSS, Ibis, 1926, p. 277.

One female, Sipora, October 26.

## HEMIGARZETTA EULOPHOTES (Swinhoe)

*Herodias eulophotes* SWINHOE, Ibis, 1860, p. 64 (Amoy, China).

*Egretta eulophotes* CHASEN and KLOSS, Ibis, 1926, p. 277.

Chasen and Kloss record a male from Sipora, but the specimen was not forwarded with the collection.

## DEMIGRETTA SACRA SACRA (Gmelin)

*Ardea sacra* GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 640 (Tahiti).

One unsexed, Sipora Island.

The United States National Museum does not possess a sufficient number of specimens from the southern part of the range of the species to enable me to work out the races, if any, into which it can be divided. The specimen submitted is quite dark, but it can be matched by other specimens from the northern part of the range and a male from the Paumotu Islands is equally dark. The Museum contains a female from Simalur Island that is also dark and quite near the Sipora bird.

## BUTORIDES JAVANICUS SIPORA Chasen and Kloss

*Butorides striatus sipora* CHASEN and KLOSS, Ibis, 1926, p. 277. (Sipora Id.)

Two adult females, Sipora; one immature, Siberut.

The above females resemble a male and female from Java very much. They are darker above and the white streak down the fore-neck is wider; there appears to be little or no difference in size. The type of *Butorides javanicus actophilus*, a female from North Pagi Island, is considerably lighter on the breast and sides of neck, has wider buffy margins to the wing-coverts and secondaries, and a considerably longer wing. The type of *Butorides javanicus icastopterus* from Simalur Island is very close to the type of *actophilus* and about the same size; it is darker on the breast. A specimen from Nias evidently belongs to *icastopterus*, if recognizable. Both *B. j. actophi-*

*lus* and *B. j. icastopterus* are larger and lighter colored than *B. j. javanicus*. The immature of *B. j. sipora* is much darker than any immature with which I have been able to compare it. I have, however, seen no immatures of *B. j. javanicus*.

The wings of the various races mentioned above measure as follows:

A male from Java, 164; female, 166.

Type of *actophilus*, North Pagi Id., 192.

Two females, Sipora Id., 170, 172.

Two males, Simalur Id. (*icastopterus*), 191 (type), 180.

One unsexed, Nias Id., 177.

The United States National Museum does not at present possess a sufficient amount of material from the wide range of the species to permit me to work out the various forms into which it has been proposed to divide it. Some of the races have been separated on very scanty material, indeed, but I prefer to leave the question in abeyance.

#### SPILORNIS ELGINI SIPORA Chasen and Kloss

*Spilornis elgini sipora* CHASEN and KLOSS, Ibis, 1926, p. 278 (Sipora Id., W. Sumatra).

One male and one female, Sipora.

While the describers are probably correct in making this a form of *S. elgini* and *S. minimus* a form of *S. cheela*, they are mistaken as regards *S. abbotti* and *S. klossi*, since both are well-marked species.

*S. abbotti* is similar to *S. e. sipora* above, but the mantle has the feathers edged narrowly with clay color and the feathers of the crest more broadly tipped with black; below, *S. abbotti* is quite different, ochraceous tawny (instead of mummy brown), the chest and upper breast being distinctly barred with blackish, with the white spots on the breast and belly smaller. *S. abbotti* also is a much larger bird, having a wing in the male ranging from 328 to 360 mm.

*S. klossi* Richmond of Great Nicobar Island is the most distinctly marked species in the genus. Quite small and very pale. Swann<sup>16</sup> examined the series in the National Museum and gave a good condensed description; a fuller description was given by the describer.<sup>17</sup> To make it a race of *S. cheela* is only to obscure its great distinctness.

#### CUNCUMA LEUCOGASTER (Gmelin)

*Falco leucogaster* GMELIN, Syst. Nat., vol. 1, 1788, p. 257 (New South Wales).

*Cuncuma leucogaster* CHASEN and KLOSS, Ibis, 1926, p. 279.

One immature male, Sipora, October 26.

<sup>16</sup> Syn. Accipitres, ed. 2, pt. 3, 1922, p. 137.

<sup>17</sup> Proc. U. S. Nat. Mus., vol. 25, 1902, p. 304.

**PERNIS PTILORHYNCHUS PTILORHYNCHUS (Temminck)**

*Falco ptilorhynchus* TEMMINCK, Pl. Col., livr. 8, March, 1821, pl. 44 (Java and Sumatra; later text to pl. 270, restricted to Java).

*Pernis apivorus ptilorhynchus* CHASEN and KLOSS, Ibis, 1926, p. 279.

One male, Siberut, September 22.

This specimen is in very peculiar plumage. The head creamy white; the center of the crown sayal brown, becoming darker on the nape, with a few very fine black shaft streaks; a broad loreal streak to the eye bister mixed with white and with fine black shaft streaks; a broad postocular streak cinnamon; chin and throat light buff; breast cinnamon buff, deepening on the belly, lower flanks, and thighs to cinnamon, the breast with narrow sepia shaft streaks, these streaks becoming mere hair lines of a much lighter color on the remainder of the lower parts; the crest is rather short and black. Blandford<sup>25</sup> describes similar specimens as the young. Like most hawks it probably goes through several stages before assuming the adult dress.

**OTUS BAKKAMOENA MENTAWI Chasen and Kloss**

*Otus bakkamoena mentawi* CHASEN and KLOSS, Ibis, 1926, p. 279 (Sipora Id., W. Sumatra).

One adult male and one immature female, Siberut; one adult male and one immature female, Sipora.

The above race has been compared by the original describers with *O. b. lempiji* of Java. A series of two males, four females, and one immature male (nearly adult) in the United States National Museum from Java is fairly uniform above (except some are slightly lighter, especially the immature); below there is quite a little variation, some have the buff tone much deeper (clay color) grading to others with little buff at all, appearing grayish. The latter are probably younger birds, as the immature one is very light. The general effect above is grayish with a tawny-olive wash.

Compared with the Javan bird, *O. b. mentawi* is, as the describers say, more deeply colored below and the other differences mentioned by them hold good; but this form is also much darker above, the upper parts being washed with cinnamon brown.

The two immatures are much lighter than the adults, one much redder than the other.

The type of *Pisorhina umbra* Richmond from Simalur Island is much smaller than *O. b. mentawi*; tawny in color with the black markings much reduced and almost lacking; the scapulars with a large white spot followed by a blackish one posteriorly on the outer web; the belly with a few white crossbars. Wing, 143 mm. *O. b.*

<sup>25</sup> Fauna Brit. India, vol. 3, 1895, p. 407.



*mentawi* has the tarsus feathered almost to the base of the toes in front, while *O. umbra* has the lower part of the tarsus bare for about a quarter of its length. *O. umbra* is a very distinct species not very closely related to *O. b. mentawi*; on Engano, however, a larger form of *O. umbra* occurs, somewhat darker on the back and lighter on the throat. It has been named *Otus umbra enganensis* Riley.<sup>19</sup>

Other localities represented by specimens of *Otus bakkamoena* in the United States National Museum show great variation and there are evidently a number of forms, but the material is not sufficient to work them out at present.

#### PSITTINUS CYANURUS PONTIUS Oberholser

*Psittinus cyanurus pontius* OBERHOLSER, *Smiths. Misc. Coll.*, vol. 60, no. 7, 1912, p. 5 (South Pagi Id.).—CHASEN and KLOSS, *Ibis*, 1926, p. 279.

Three males and two females, Sipora; three males, Siberut.

Comparing specimens of the same age from Siberut and Sipora with those of South Pagi, there seems to be little or no difference. The majority of the South Pagi birds are more yellowish below, more inclined to grayish on the mantle with crown not so deep a blue, but this is due to age.

Simalur Island is inhabited by the very distinct *Psittinus abbotti* Richmond.<sup>20</sup>

#### LORICULUS GALGULUS GALGULUS (Linnaeus)

*Psittacus galgulus* LINNAEUS, *Syst. Nat.*, ed. 10, 1758, p. 103 (India).

*Loriculus galgulus* CHASEN and KLOSS, *Ibis*, 1926, p. 280.

One male, one female, and one unsexed, Siberut; two males and three females, Sipora.

The specimens from Siberut and Sipora apparently do not differ appreciably from birds from the mainland, Sumatra, and Borneo.

*Loriculus galgulus lamprochlorus* Oberholser<sup>21</sup> from Nias is not different enough to warrant recognition in my opinion. The type is an exceptionally small bird, but a young male from the same island is as large as many males from Sumatra and Borneo. It apparently does not differ in color. The type of *L. g. dolichopterus* Oberholser<sup>21</sup> from Engano can not be matched by any specimen before me as to size or color. It is larger than *L. g. galgulus*, lighter on the back, more greenish rather than yellowish below; and the forehead bluish glaucous. It measures: Wing, 88; tail, 34; culmen from cere, 11.5. A female from Sipora approaches it as to length of wing, but it is the only specimen in quite an extensive series that does. The race was founded upon a single female; it apparently is a valid form.

<sup>19</sup> *Proc. Biol. Soc. Washington*, vol. 40, 1927, p. 93.

<sup>20</sup> *Idem*, vol. 13, 1902, p. 188.

<sup>21</sup> *Smiths. Misc. Coll.* vol. 60, no. 7, 1912, p. 5.

## EURYSTOMUS ORIENTALIS CALONYX Sharpe

*Eurystomus calonyx* SHARPE, Proc. Zool. Soc. London, 1890, p. 551 (Nepal).  
*Eurystomus orientalis calonyx* CHASEN and KLOSS, Ibis, 1926, p. 280.

One male, Sipora, October 29.

This specimen is quite dark, especially the head and upper back. It agrees more nearly with the form found in northeast China than with any of the other forms into which the species has been divided. It is evidently a bird of the year; the maxilla is blackish, red only at the base. The wing measurement given by Chasen and Kloss (281) is much too large; I make it, 195.

## RAMPHALCYON CAPENSIS ISOPTERA Oberholser

*Ramphalcyon capensis isoptera* OBERHOLSER, Proc. U. S. Nat. Mus., vol 35, 1909, p. 671 (Sikakap Strait, Pagi Islands).

*Ramphalcyon capensis* CHASEN and KLOSS, Ibis, 1926, p. 280.

One adult male and two adult females, Siberut; six adult males and one immature male, Sipora.

The above series represents two phases, a dark-headed and a light-headed one, but I do not think they are different forms. Neither phase seems to be confined to one island and the measurements show no difference. The series from the Pagi Islands show the two phases. The blue of the rump and back in the Siberut birds is a little bit deeper than in those from Sipora, but the difference is very slight. Taking the Siberut-Sipora series as a whole they agree rather closely with *R. c. isoptera* of the Pagi Islands, both in color and size. The Siberut-Sipora series have a wing, 146.5-158.5; culmen, 77.5-85 mm. The Pagi Island birds, wing, 148-159; culmen, 77.5-87 mm.

*Ramphalcyon capensis nesoecca* Oberholser from Nias Island has a lighter-colored head than *isoptera*.

*Ramphalcyon capensis simalurensis* Richmond of Simalur is much darker below, with the mantle more brownish than in *isoptera*.

*Ramphalcyon capensis sodalis* Richmond from Pulo Tuangku, Banjak Islands, is a larger, bluer-backed edition of *simalurensis*.

So far as known, there are four more or less well-marked races of this kingfisher on the islands off the west coast of Sumatra from Simalur south to the Pagi Islands, as given above. No form has been described from Engano, the most isolated island of the group.

## ALCEDO ATTHIS BENGALENSIS Gmelin

*Alcedo bengalensis* GMELIN, Syst. Nat., vol. 1, pt. 1, 1788, p. 450 (Bengalen).

*Alcedo atthis bengalensis* CHASEN and KLOSS, Ibis, 1926, p. 281 (Siberut).

One female, Siberut, September 27.

Probably a migrant.

## ALCEDO MENINTING PROXIMA Richmond

*Alcedo meninting proxima* RICHMOND, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 104 (North Pagi Island).

*Alcedo meninting* CHASEN and KLOSS, Ibis, 1926, p. 281.

One adult male, Sipora.

The above specimen is more greenish above and lighter below than the type of *proxima*; in the latter character it can be matched by a female from North Pagi, but in the former there is no specimen in the North Pagi series consisting of five specimens that matches it.

*Alcedo meninting callima* and *Alcedo meninting subviridis* Oberholser,<sup>22</sup> from the Batu Islands and Nias, respectively, agree in being much deeper blue above than *A. m. proxima*. They are much alike; the only difference I can detect is the apparently longer bill of *A. m. callima*, but this presumed difference might disappear with a larger series. The series of *A. m. callima* consists of three specimens from the Batu Islands; that of *A. m. subviridis*, three from Nias and one from Pulo Tuangku, Banjak Islands.

## CEYX RUFIDORSUS RUFIDORSUS Strickland

*Ceyx rufidorsa* STRICKLAND, Proc. Zool. Soc. London, 1846 (1847), p. 99 (Malacca); cf. Hartert, Nov. Zool., vol. 9, 1902, p. 430.

*Ceyx rufidorsus rufidorsus* CHASEN and KLOSS, Ibis, 1926, p. 281 (part).

One male, Siberut; three males and one female, Sipora.

The United States National Museum has a male and a female from the Batu Islands (Tana Bala and Tana Masa).

The above series seems to have more of the Chinese violet wash above when compared with the series in the Museum from various islands in the South China Sea, Borneo, and Sumatra, though the female from Sipora is as red on the mantle as Bornean birds. One male from west Sumatra has as much of the purple wash as Sipora birds. The presence or intensity of the purple wash must be more or less individual. There appears to be no difference in size.

## CEYX DILLWYNNI Sharpe

*Ceyx dillwynni* SHARPE, Proc. Zool. Soc. London, 1868, pp. 591, 593 (Labuan).

*Ceyx rufidorsus rufidorsus* CHASEN and KLOSS, Ibis, 1926, p. 281 (part).

An unsexed adult specimen from Sipora, November 26, apparently belongs to this species; it is quite different from *C. r. rufidorsus* with which it was taken on the same day. Below it is white, with an ochraceous orange band across the breast, the flanks of the same color, instead of the light cadmium of *C. r. rufidorsus*; the mantle is black, the feathers rather broadly tipped with ochraceous orange. It

<sup>22</sup> Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 7.

may be not true *C. dillwynni* at all, but it agrees fairly well with specimens from Johore and East Sumatra, except it has more black in the mantle and the scapulars are scarcely washed with blue at all. The tail is black, the inner webs of the feathers ochraceous orange; the latter may be an indication that the specimen is not fully adult.

#### ENTOMOTHERA COROMANDA PAGANA Oberholser

*Entomothera coromanda pagana* OBERHOLSER, Proc. U. S. Nat. Mus., vol. 48, 1915, p. 648 (North Pagi Id., W. Sumatra).

*Halcyon coromanda minor* CHASEN and KLOSS, Ibis, 1926, p. 281.

One adult and one subadult female, Siberut; one adult male, Sipora.

These seem to be identical with North Pagi specimens. *E. c. neophora* Oberholser from East Sumatra seems to be practically identical in color with *E. c. pagana*, but the latter has a longer wing. *E. c. minor* from Borneo is darker and smaller than *E. c. neophora*. All these races have been founded on rather scanty material, but as they show some slight differences are at least worthy of provisional recognition.

#### SAUROPATIS CHLORIS CHLOROPTERA Oberholser

*Sauropatis chloris chloroptera* OBERHOLSER, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 379 (Sibabo Bay, Simalur Id.)

*Halcyon chloris chloroptera* CHASEN and KLOSS, Ibis, 1926, p. 282.

One female, Siberut Island.

The single female submitted agrees with a series from Simalur Island. *Sauropatis chloris amphiryta* Oberholser of Nias hardly differs in size or color from the Simalur bird and is hardly worthy of recognition. Specimens from Engano Island are much smaller than *S. c. chloroptera* and represent a well-marked race, *Sauropatis chloris azela* Oberholser.<sup>23</sup> We thus have two races on the islands off the west coast of Sumatra:

(1) *Sauropatis chloris chloroptera* from Simalur south to the Pagi Islands; and

(2) *Sauropatis chloris azela*, confined to Engano.

If the Nias bird were recognized, it would make a break in the range of *S. c. chloroptera* which the slight differences assigned to *amphiryta* by its describer and shown by the specimens does not warrant.

#### HALCYON CONCRETA (Temminck)

*Dacelo concreta* TEMMINCK, Pl. Col., livr. 58, May, 1825, pl. 346 (Sumatra).

*Halcyon concreta* CHASEN and KLOSS, Ibis, 1926, p. 282.

One immature male, Siberut.

<sup>23</sup> Proc. U. S. Nat. Mus., vol. 55, 1919, p. 377.

There are no immature males in the National Museum with which to compare it. It does not agree with Sharpe's description<sup>24</sup> of this plumage, but resembles the female; the back is darker, duller green, and lacks the ochraceous spots; the feathers of the chest and breast are edged with blackish. There are a few dark-blue feathers of the adult plumage appearing on the back.

**HYDROCISSA CONVEXA CONVEXA (Temminck)**

*Buccros convexus* TEMMINCK, Pl. Col., livr. 89, February, 1832, pl. 530 (Java and Sumatra).

*Anthracoceros coronatus convexus* CHASEN and KLOSS, Ibis, 1926, p. 282.

Two males and four females, Siberut and two males, Sipora.

The National Museum contains four males from Nias, one male (marked female) and three females (unsexed) from North Pagi Island, two males, South Pagi Island, one male, Pulo Mansalar, W. Sumatra, and a good series from the mainland, the Tambelans, and Borneo, but only one male from Sumatra and one female from Java.

All the above apparently belong to one form and have a wing from 260 to 305; average 14 specimens 288 mm.

The bird from Tana Bala, Batu Islands, has been separated as *Hydrocissa convexa barussensis* Oberholser<sup>25</sup> and was based on two males with a longer wing measurement. The specimens have wings of the same length, 315 mm., but whether this difference would be maintained in a larger series is problematical. It is undeniably greater than in any male I have been able to measure from any other part of the range of the species, but not as great as the variation within *Hydrocissa c. convexa*.

**MEROPS PHILIPPINUS JAVANICUS Horsfield**

*Merops javanicus* HORSFIELD, Trans. Linn. Soc. London, vol. 13, 1821, p. 171 (Java).

*Merops superciliosus javanicus* CHASEN and KLOSS, Ibis, 1926, p. 283.

Three males, three females, and one unsexed, Siberut, September 16–October 2.

The above series are in worn and faded condition; the backs and lower parts much mixed with blue. *Merops philippinus philippinus* of the Philippine Islands has the back and breast washed with buffy; in the worn state, the buffy wash is accentuated. Specimens from other parts of the range of the species have the breast more washed with greenish, with little or no buffy suffusion. Siberut birds belong to the Javan race. The United States National Museum also has specimens of this race from Simalur Island, Batu Islands (Tana Bala), and South Pagi Island.

<sup>24</sup> Cat. Birds. Brit. Mus., vol. 17, 1892, p. 286.

<sup>25</sup> Journ. Washington Acad. Sci., vol. 14, 1924, p. 300.

I must confess that I can see no practical utility in making races of forms distant geographically because of resemblances in plumage. It is in some cases positively misleading and obscures fundamental differences. Two forms of the same genus that are widely separated and differ quite markedly, even though there are certain resemblances, may have had quite different origins or have come from a common ancestor now extinct.\* For all practical purposes they are now species, with their own set of forms or not as the case may be. Species, at least in the case of land birds, should have more or less of a continuous distribution. Birds of the same genus widely separated geographically and easily distinguished had best be treated as species, even though they may resemble some distant form; the resemblance is covered by the genus.

**COLLOCALIA VESTITA AEROPHILA** Oberholser

*Collocalia fuciphaga aerophila* OBERHOLSER, PROC. U. S. Nat. Mus., vol. 42, 1912, p. 16 (Siaba Bay, Nias Island).—CHASEN and KLOSS, *Ibis*, 1926, p. 283.

One male and two females, Sipora.

These have been compared with the type of *aerophila*. They have a slight greenish gloss on the wings not seen in the type, but I can detect no other differences, and as the Nias bird was described from a single specimen it may not represent the form typically. A single female in the Museum from Simalur Island has the wing a duller, almost glossless black and the sides of the face lighter than *aerophila*. It has been referred to *C. vestita vestita* by Oberholser,<sup>26</sup> but this disposition of it I am inclined to doubt is the correct one. I have been unable to find the male specimen from the same island mentioned in the paper cited.

**COLLOCALIA LINCHI OBERHOLSERI** Stresemann

*Collocalia linchi oberholseri* STRESEMANN, NOV. Zool., vol. 19, 1912, p. 348 (North Pagi Island).—CHASEN and KLOSS, *Ibis*, 1926, p. 283.

Two females, Sipora.

These two specimens have shorter wings than any in the typical series from North Pagi Island, consisting of two males, one female, and two unsexed birds. The two males measure: Wing, 104, 106.5; tail, 43, 43. The female: Wing, 107.5; tail, 41. The two unsexed: Wing, 105, 106; tail, 42.5, 42.5. The two females, Sipora: Wing, 95, 103; tail, 41, 40. There appear to be no constant differences in color. With a larger series from Sipora the supposed difference in the length of wing would probably disappear.

<sup>26</sup> Proc. U. S. Nat. Mus., vol. 42, 1912, p. 16.

*Collocalia linchi linchi* from Java, of which the Museum now has a good series, is so very different in color from the races credited to this species that it is very doubtful if they should continue to be regarded as forms of it. The Javan series stand out from the other races of the species in having the upper parts washed with dark ivy green; all the other races of the species, at least so far as represented in the United States National Museum, have the upper parts washed with dull blue-green black. These colors are hard to match or define, but perfectly obvious to the eye. The differences are so pronounced that it would be better, from a practical standpoint, to recognize *C. l. linchi* of Java as a distinct species without subspecies.

#### HEMIPROCNE COMATA COMATA (Temminck)

*Cypselus comatus* TEMMINCK, Pl. Col., livr. 45, April, 1824, pl. 268 (Sumatra).—CHASEN and KLOSS, Ibis, 1926, p. 283.

Five males and four females, Siberut.

Apparently not different from Sumatran specimens. The National Museum also has it from Nias, Tana Bala (Batu Islands), and North Pagi Island.

#### HIEROCOCCYX FUGAX (Horsfield)

*Cuculus fugax* HORSFIELD, Trans. Linn. Soc. London, vol. 13, 1821, p. 178 (Java).

*Hierocoecyx fugax* CHASEN and KLOSS, Ibis, 1926, p. 283.

Two immature birds, Siberut. These are, as Chasen and Kloss remark, "too young to deal with subspecifically."

#### CACOMANTIS MERULINUS THRENODES Cabanis and Heine

*Cacomantis threnodes* CABANIS and HEINE, Mus. Hein., vol. 4, 1862, p. 19 (Malacca).

*Cacomantis merulinus threnodes* CHASEN and KLOSS, Ibis, 1926, p. 284.

Four males and two females, Siberut.

Only two of the above are fully adult. The United States National Museum contains only one specimen from Malacca; it is deeper in color on the breast and belly than the two adult males from Siberut, but Chasen and Kloss<sup>27</sup> have compared Federated Malay States specimens with those from Siberut and found them not separable.

Oberholser<sup>28</sup> diagnosed the Nias Island form as *Cacomantis merulinus subpallidus*, assigning as characters smaller size with head and lower parts paler. The character of smaller size does not hold, but it is paler than the specimens from Siberut. Whether the differences are great enough to warrant recognition I am unable to decide without examining additional material. It was founded on two males,

<sup>27</sup> Ibis, 1926, p. 284.

<sup>28</sup> Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 4.

the type not quite adult. They measure (the type first): Wing, 98-102; tail, 95-105; culmen, 19.5-19 mm. The two Siberut males measure: Wing, 104-100; tail, 98.5-97; culmen, 18.5-18.5 mm.

**CHALCOCOCCYX XANTHORHYNCHUS (Horsfield)**

*Cuculus xanthorhynchus* HORSFIELD, TRANS. Linn. Soc. London, vol. 13, 1821, p. 179 (Java).

*Chalcococcyx xanthorhynchus* CHASEN and KLOSS, Ibis, 1926, p. 284.

One male, Sipora.

The United States National Museum contains only five specimens of this species. Three from Sumatra, one from Palawan, and one from Mindanao, Philippines. The three Sumatran specimens are somewhat alike; all have a bronzy wash mixed with the violet of the upper parts. The Sipora specimen lacks the bronzy wash on the upper parts and the violet comes near prune purple (blackish purple in the Sumatran specimens); the bill is about the same size as the Sumatran birds. In color the Palawan bird is like that of Sipora, but the bill is much smaller. The specimen from Mindanao is somewhat intermediate between that of Sumatra and Palawan, but the bill is about the same size as in the Sumatran specimens. When sufficient material is available it will probably be found that the species breaks up into a number of more or less well-defined races.

**CENTROPUS SINENSIS BUBUTUS Horsfield**

*Centropus bubutus* HORSFIELD, TRANS. Linn. Soc. London, vol. 13, 1821, p. 180 (Java).

*Centropus sinensis bubutus* CHASEN and KLOSS, Ibis, 1926, p. 284.

One male, Siberut.

The National Museum possesses only a male and female of the coucal from Java: the female much more purplish on the hind-neck than the male. The Siberut specimen resembles the Javan male, except the iridescence on the hind-neck is more bluish and the tail is more bronze green; they are about the same size.

Three adult males and two unsexed adults from Nias Island are more purplish on the hind-neck, but do not differ in size. The color of the hind-neck seems to vary somewhat, probably due to age.

**UROCOCCYX AENEICAUDA (J. and E. Verreaux)**

*Phoenicophaeus aeneicaudus* J. and E. VERREAUX, Rev. et Mag. Zool., 1855, p. 375 (Ceylon, error: type locality designated by Chasen and Kloss, Ibis, 1926, p. 285, Sipora Island).

*Phoenicophaeus curvirostris aeneicaudus* CHASEN and KLOSS, Ibis, 1926, p. 284.

Three males, six females, and one unsexed, Siberut; six males, six females, and one unsexed, Sipora.



The specimens from the two islands do not seem to differ in any way. The National Museum collection contains two males, one female, and one unsexed example from North Pagi Island and one male and two unsexed birds from South Pagi Island. These apparently do not differ in color from the Siberut-Sipora series, but the males apparently have a slightly longer wing. The nine males from Siberut-Sipora have a wing, 161–173.5 (average 166.5); three males from the Pagi Islands, 175–180.5 (average 177.5) mm. This difference, however, might disappear with a larger series from the latter locality.

As Chasen and Kloss have remarked<sup>29</sup> *aeneicauda* has a differently shaped nostril from *erythrognathus* (type of the genus *Urococcyx* Shelley), and *borneensis* has another style different from either. They are all apparently closely related and it may be that the shape of the nostril has no generic significance in these birds.

CALYPTOMENA VIRIDIS SIBERU Chasen and Kloss

*Calyptomena viridis siberu* CHASEN and KLOSS, Ibis, 1926, p. 285 (Siberut Island).

Two adult males and five immature males, Siberut.

This appears to be a very good race. It is much darker, less yellowish green than *C. v. continentis*; it also appears to be somewhat larger. One immature male from North Pagi and three females from South Pagi in the National Museum probably belong to the Siberut form; they have longer wings than birds from the mainland. I have been unable to compare *C. v. siberu* with *C. v. viridis*, of Sumatra, as this form is not represented at present in the National Museum.

PITTA MOLUCCENSIS MOLUCCENSIS (P. L. S. Müller)

*Turdus moluccensis* P. L. S. MÜLLER, Natursyst. Suppl., 1776, p. 144 (Moluccas, error; Tenasserim).

*Pitta brachyura cyanoptera* CHASEN and KLOSS, Ibis, 1926, p. 285.

One unsexed bird, Sipora, Nov. 3.

This specimen differs in the color of the rump from any I have been able to examine from Sumatra and the mainland. In the latter the rump is deep dull violaceous blue, while in the Sipora bird it is venetian blue. It does not differ in size from Sumatran specimens, and the color of the rump may be aberrant, hence I hesitate to name it.

*Pitta moluccensis lept*a Oberholser<sup>30</sup> was founded upon two males from Siaba Bay, Nias, and one female from Pulo Tuanku, Banjak Islands. The only characters given are smaller size, especially the

<sup>29</sup> Ibis, 1926, p. 285.

<sup>30</sup> Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 8.

bill. Five males and two females from east Sumatra measure: Wing, 119–130.5 (125); culmen, 26–29 (28) mm. The two males from Nias: Wing, 118–119; culmen, 25–26 mm. The female from Pulo Tuanku: Wing, 117.5; culmen, 25 mm. There are apparently no constant color differences.

The type of *P. m. lepta* has blackish central strips on the feathers of the mantle and some of the middle wing coverts have a deep green central stripe. The Pulo Tuanku specimen is similar and I have found a few mainland specimens in like condition; possibly an age character.

**HIRUNDO RUSTICA GUTTURALIS Scopoli**

*Hirundo gutturalis* SCOPOLI, Del. Flor. et Faun. Insubr., vol. 2, 1786, p. 93 (New Guinea).

*Hirundo rustica gutturalis* CHASEN and KLOSS, Ibis, 1926, p. 286.

One female. Siberut, September 17.

**ARIZELOMYIA LATIROSTRIS LATIROSTRIS (Raffles)**

*Muscicapa latirostris* RAFFLES, Trans. Linn. Soc. London, vol. 13, 1821, p. 312 (Sumatra).

*Alcedonax latirostris* CHASEN and KLOSS, Ibis, 1926, p. 286.

One male (so marked on label), Siberut.

This is a very brown-backed bird, the chest with dusky streaks. The upper parts are browner than in any specimen with which I have been able to compare it. It is a bird of the year in fresh autumnal plumage which may account for the browner, more ferruginous plumage.

**MUSCITREA GRISOLA VANDEPOLLI (Finsch)**

*Pachycephala vandepolli* FINSCH, Notes Leyden Mus., vol. 20, 1899, p. 224 (Pulo Tello, Batu Islands).

*Muscitrea grisola nesiotis* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 11 (Sibabo Bay, Simalur Island).

*Muscitrea grisola grisola* CHASEN and KLOSS, Ibis, 1926, p. 287.

One male and one female, Siberut.

*Muscitrea grisola nesiotis* was founded upon a male and female and while they are browner on the upper parts and the head is duller, browner gray than in *Muscitrea grisola grisola* from the mainland on an average, yet there are specimens of the latter that match them in this respect. The Simalur specimens have a larger bill, however. The description of *Pachycephala vandepolli* Finsch<sup>31</sup> seems to fit it very well, though the measurements given for the culmen are somewhat smaller than those I obtain for the Simalur male, but this apparent difference may be due to employing a different method of measurement.

<sup>31</sup> Notes Leyden Museum, vol. 20, 1899, p. 224.

The two Siberut specimens agree with those from Simalur in size, but are of a lighter, less rufescent brown on the back; they are in more worn, less fresh plumage, however.

There is a young female, in the United States National Museum (179947), from South Pagi Island which has the top of the head brownish olive instead of deep mouse gray; back lighter and more rusty brown; secondaries outwardly edged with tawny; lower mandible horn color, except at tip. These differences are due to age in my opinion.

Five males of *M. g. grisola*, measure: Wing, 82-87 (83.9); culmen, 13-15 (13.9) mm.

Type of *M. g. nesiotis* (Simalur): Wing, 87; culmen, 15 mm.

The male from Siberut: Wing, 85; culmen, 17.

Two females of *M. g. grisola*: Wing, 77-83; culmen 13.5-14.

One female from Simalur: Wing, 86; culmen, 15.

One female from Siberut: Wing, 83; culmen, 15.

One immature female from South Pagi: Wing, 79; culmen, 15.

#### HYPOTHYMIS AZUREA LEUCOPHILA Oberholser

*Hypothymis azurea leucophila* OBERHOLSER, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 607 (North Pagi Island, W. Sumatra).

*Hypothymis azurea sipora* CHASEN and KLOSS, Ibis, 1926, p. 287 (Sipora Island, W. Sumatra).

Five males and one female, Siberut; five males and three females, Sipora.

The material submitted seems to be identical with the small series in the United States National Museum from the Pagi Islands on which the name *leucophila* was founded.

On the west Sumatra islands the following species and forms are found:

*Hypothymis abbotti* Richmond, Pulo Babi and Pulo Lasia.

*Hypothymis azurea consobrina* Richmond, Simalur Island.

*Hypothymis azurea amelis* Oberholser, Nias Island.

*Hypothymis azurea isocara* Oberholser, Banjak Islands.

*Hypothymis azurea ponera* Oberholser, Batu Islands.

*Hypothymis azurea leucophila* Oberholser, Mentawi Islands.

*Hypothymis azurea richmondi* Oberholser, Engano Island.

The Mentawi form is the only one in the above list with a white belly, and it is more nearly related to the subspecies occurring on Sumatra.

#### CULICICAPA CEYLONENSIS AMPHIALA Oberholser

*Culicicapa ceylonensis amphiala* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 12 (North Pagi Island, W. Sumatra).

*Culicicapa ceylonensis pectenocara* CHASEN and KLOSS, Ibis, 1926, p. 288.

Three males, two females, and one unsexed skin, Siberut.

The series agrees with two males (one the type) from North Pagi Island.

Two specimens from Simalur Island (*Culicicapa ceylonensis percnocara* Oberholser) and two from Nias Island (*Culicicapa ceylonensis pellowota* Oberholser) described in the same paper with the Pagi bird belong apparently to one form. They agree, however, in having the throat and chest darker, the breast and belly a deeper yellow, the pileum darker, and the backs more yellowish than in the Mentawi form. The name *Culicicapa ceylonensis percnocara*, stands first on the page and is the one to be used, with *pellowota* as a synonym. There is no appreciable difference in size between the two forms.

**GRAUCALUS SUMATRENSIS CRISSALIS Salvadori\***

*Graucalus crissalis* SALVADORI, Ann. Mus. Civ. Storia Nat. Genova, ser. 2, vol. 14, 1894, p. 592 (Si Oban, Sipora Id.).

*Artamides sumatrensis halistephis* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 14 (South Pagi Id.).

*Coracina sumatrensis crissalis* CHASEN and KLOSS, Ibis, 1926, p. 288.

Six adult males, three immature males, and nine females, Sipora; four adult males and four females, Siberut.

The series from Siberut appears to be slightly darker and on the average a trifle smaller than that from Sipora, but the differences are too slight, in my opinion, to warrant providing it with a name. I can not appreciate any differences between South Pagi Island specimens and those from Sipora. Doctor Oberholser, in naming *A. s. halistephis*, apparently overlooked Salvadori's description of *G. crissalis*.

*Graucalus s. crissalis* is the darkest of all the forms thus far described from the islands off the west coast of Sumatra, with the possible exception of *Graucalus sumatrensis kannegieteri* of Nias, of which I have seen no specimens.

**VOLVOCIVORA CULMINATA CULMINATA (A. Hay)**

*Cebblepyris culminatus* A. HAY, Madras Journ. Liter. and Sci., vol. 13, pt. 2, 1844 (1845), p. 157 (Malacca).

*Lalage fimbriata culminata* CHASEN and KLOSS, Ibis, 1926, p. 289.

Two males and one female, Siberut.

The males agree with a specimen of this form from the Kateman River, E. Sumatra, in color and size. The type of *Campephaga compta* Richmond and another female from Simalur Island are darker above, the postocular stripe is broader; it is more heavily barred below than in the single female from Siberut. The Simalur bird evidently represents a recognizable form. A pair of *Volvocivora fimbriata* from Java in the United States National Museum are so much darker than *culminata* that I can see no utility in making the latter a form of it. *A. culminata* is, however, evidently divisible into several forms.

Stuart Baker<sup>32</sup> says *Campephaga* is preoccupied, but I can not find that this is so. I would, however, restrict this name to the African species and use *Volvocivora* Hodgson for the Asiatic birds usually placed in *Campephaga*. *Lalage* Boie should be restricted to *Lalage nigra* (Forster) and its allies.

**IRENA PUELLA CRINIGERA Sharpe**

*Irena criniger* SHARPE, Cat. Birds. Brit. Mus., vol. 3, 1877, p. 267 (Borneo).

*Glauconympha cyanea megacyanea* OBERHOLSER, Journ. Washington Acad. Sci., vol. 7, 1917, p. 540 (Pulo Tuanku, Banjak Islands).

*Irena puella crinigera* CHASEN and KLOSS, Ibis, 1926, p. 289.

A large series of adults and immatures from Sipora and Siberut. The United States National Museum has a series from Pulo Tuanku, Banjak Islands, Nias, South Pagi Island, and Tana Bala, Batu Islands. All of these seem to belong to one form along with the material from Sipora-Siberut. Comparing this series with one from Borneo and Sumatra, I can detect no constant difference in size or color. The males in the Borneo-Sumatran series, on an average, seem to have the upper and under tail coverts longer, but this is not constant.

The wings of the males measure as follows:

- Five from Siberut, 118.5-123.
- Three from Sipora, 118-122.5.
- Two from South Pagi, 124.5.
- One from Batu Islands, 121.5.
- Two from Banjak Islands, 124-125.
- One from Nias, 128.5.
- Five from Borneo and Banka, 118-122.5.

The wings of the females measure as follows:

- Four from Siberut, 118.5-122.5.
- One from Sipora, 117.
- One from South Pagi, 121.
- One from Banjak Islands (type of *megacyanea*), 119.
- One from Nias, 121.
- Four from Borneo and Sumatra, 115.5-120.

**BRACHYPODIUS ATRICEPS CHRYSOPHORUS (Oberholser)**

*Microtarsus melanocephalus chrysophorus* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 10 (South Pagi Island).

*Brachypodius atriceps atriceps* CHASEN and KLOSS, Ibis, 1926, p. 289.

Four males and four females, Siberut; three males, two females, and one unsexed, Sipora.

The above material agrees with that in the United States National Museum from South Pagi Island, consisting of five males and three

<sup>32</sup> Fauna Brit. India, Birds, ed. 2, vol. 2, 1924, p. 336.

females. The latter series differs from one from Sumatra and the mainland in being more golden on the posterior lower parts; on an average, viewed in series, the back is deeper, not quite so greenish yellow. I can detect no difference in the color of the rump between Mentawi and the Sumatra-Mainland series, however. There are individual specimens in the two series that can hardly be told apart, but on the whole there is a good average difference. There is an immature specimen in the National Museum from North Pagi Island and two females from Nias Island that I would assign also to *chrysophorus*.

*Brachypodius melanocephalus hyperemus* (Oberholser) from Simalur Island is a very well marked form, with a larger bill than either *atriceps* or *chrysophorus* and on an average is also darker on the chest and back.

In this species the sexes are similar but the female averages slightly smaller, has a shorter bill, and is greener not so yellowish on the back and chest.

Three males from Sumatra (2) and Banka (1), measure: Wing, 76-79 (77.5); culmen, 13.5-14 (13.8) mm.

Three males from Trong, Peninsular Siam: Wing, 78.5-82.5 (79.2); culmen, 13.5-14 (13.8) mm.

Five males from South Pagi Island: Wing, 76.5-80 (77.8); culmen, 14-14.5 (14.4).

Three males from Sipora: Wing, 73.5-78.5 (75.3); culmen, 13.5-14 (13.8).

Four males from Siberut: Wing, 73.5-79 (75.4); culmen, 13.5-14 (13.8).

Ten males from Simalur: Wing, 77-82 (79.1); culmen, 14.5-15.5 (14.8).

#### MICROTARSUS MELANOLEUCOS PROXIMUS Riley

*Microtarsus melanoleucos proximus* RILEY, Proc. Biol. Soc. Washington, vol. 40, 1927, p. 96 (Siberut Island).

*Microtarsus melanoleucus* CHASEN and KLOSS, Ibis, 1926, p. 290.

Four males and three females, Siberut.

The female in this species differs from the male in slightly smaller size and the more brownish, less blackish tone of the plumage. Comparing the four males from Siberut with one male from Malacca and two from Borneo, the first mentioned series is much deeper black, with little or no brownish shade. The females from Siberut are more like the males from Borneo and may only with difficulty be distinguished. The females from Borneo are more brownish than those from Siberut and could hardly be called blackish at all. I can detect no difference worthy of note between the single male from Malacca and those of Borneo.

Four males from Siberut measure: Wing, 82-88 (84.6); culmen, 14-15 (14.6) mm.

One male from Malacca and two from Borneo, measure: Wing, 84.5-85.5 (84.8); culmen, 15-15.5 (15.2) mm.

**PYCNONOTUS PLUMOSUS PORPHYREUS** Oberholser

*Pycnonotus plumosus porphyrcus* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 11 (North Pagi Island).

*Pycnonotus plumosus inornatus* CHASEN and KLOSS, Ibis, 1926, p. 290.

Eleven males and six females, Sipora; four males and five females, Siberut.

The above material agrees with the series in the United States National Museum from the Pagi Islands, Nias, Banjak, and Batu Islands, Pulo Mansalar and Tapanuli Bay, West Sumatra, all of which evidently represent one race. A series from east Sumatra, Banka, Billiton, the Malay Peninsula islands off Singapore, and south Tenasserim represent another race, paler below—especially on the belly—than the one from west Sumatra. The type locality of *Pycnonotus plumosus* Blyth is Singapore. Chasen and Kloss record the irides of the Mentawi and Sumatran birds as yellow and those from the mainland as red. This agrees with Dr. W. L. Abbott's notes on the color of the eyes for birds of the islands off the west coast of Sumatra and Tapanuli Bay, west Sumatra, but the birds from east Sumatra he records as crimson brown and those from the mainland as dull red or reddish brown. There are thus evidently two forms of the species occurring in Sumatra, one in the east and the other in the west and the islands off the coast. This makes the application of Bonaparte's<sup>33</sup> name, *Pycnonotus inornatus* uncertain, until some one familiar with the forms of this species has an opportunity to examine the type in Leyden. For the present it is better to use a name of certain application. There appears to be little or no difference in size between the two forms.

**COPSYCHUS SAULARIS PAGIENSIS** Richmond

*Copsychus saularis pagiensis* RICHMOND, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 105 (North Pagi Id.).—CHASEN and KLOSS, Ibis, 1926, p. 291.

One adult male and two adult females, Sipora; one immature female, Siberut.

The above adult male agrees with the type of *C. s. pagiensis* fairly well. The wing in the type is a trifle shorter, but it has a longer bill than the Sipora male; in the latter the extreme tip of the bill is missing, but this is not enough to account for the difference. The culmen in the type measures 23.5; in the Sipora male, 19+. The culmen in the two females measures 22.5, 20 mm.; in a female from North Pagi, 22. In the immature bird from Siberut the culmen measures 22.5 and it undoubtedly belongs to this large long-billed race.

<sup>33</sup> Consp. Gen. Av., vol. 1, 1850, p. 263 (Sumatra).

## COPSYCHUS SAULARIS subspecies

*Copsychus saularis* CHASEN and KLOSS, Ibis, 1926, p. 291.

Two unsexed examples, Siberut.

The above two specimens are apparently females in molt, and one is certainly a bird of the year, as it still retains some of the spotted feathers on the side of the throat. Both have rather small bills (19 and 19.5 mm.), much smaller than the still younger female that I have assigned to *pagiensis*. It is possible that there are two forms of this thrush occurring together on Siberut, and possibly on Sipora (the female assigned to *pagiensis* with the culmen 20 mm.). Should this prove to be the case, *pagiensis* would be entitled to full specific rank.

Two other races have been described from islands off the west coast of Sumatra, namely:

*Copsychus saularis zacnecus* Oberholser, Simalur Island, and

*Copsychus saularis nesiarchus* Oberholser, Nias Island.

Both are small-billed forms like the present. The Simalur bird with a culmen 21–20 mm. in the male; 19.5 in the female. The Nias bird, 18–21 mm. The two forms are much alike and may eventually have to be united under the older name proposed for the Simalur bird. They were originally established on scanty and insufficient material, consisting of two males and one female from Simalur and two males from Nias.

## KITTACINCLA MELANURA MELANURA Salvadori

*Cittocinclla melanura* SALVADORI, Ann. Mus. Civ. Stor. Nat. Genov., ser. 2, vol. 4, 1887, p. 549, pl. 8, fig. 1 (Nias Island).

*Kittacinclla melanura hypoliza* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 13 (Simalur Island).

*Kittacinclla melanura opisthochra* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 13 (Pulo Lasia).

*Kittacinclla melanura pagiensis* OBERHOLSER, Smiths. Misc. Coll., vol. 76, no. 6, 1923, p. 3 (North Pagi Island).

*Kittacinclla malabarica melanura* CHASEN and KLOSS, Ibis, 1926, p. 291.

One adult male, two immature males, and one female, Sipora; one young male, Siberut.

The type of *Kittacinclla melanura pagiensis* Oberholser, is a bird of the year molting into the adult plumage. It is matched in size by the immature males from Sipora and fairly well as to color. The form was founded on the single specimen. The adult male from Sipora can not be distinguished in color or size from a series from Nias; the bill is a little longer but not enough to be significant in a single specimen. Allowing for seasonable differences, I can not detect any characters that will separate the Simalur and Pulo Lasia and Pulo Babi birds from that of Nias. In other words, as far as our



material shows, there is only one well-defined form of this type on the islands off the west coast of Sumatra.

The various series measures as follows:

Four males, Nias: Wing, 87-96 (91); culmen, 15.5-17 (16.4).

Three males, Simalur: Wing, 90-93 (90); culmen, 16-17 (15.5).

One male, Pulo Babi: Wing, 96; culmen, 16.5.

One male, Sipora: Wing, 93; culmen, 18.

Two females, Nias: Wing, 84; culmen, 16.

Two females, Simalur: Wing, 86; culmen, 15-16 (15.5).

One female, Pulo Babi: Wing, 84; culmen, 16.5.

One female,<sup>34</sup> Pulo Lasia (type): Wing, 92; culmen, 17.

Type of *K. m. pagiensis*,<sup>35</sup> wing, 84; culmen, 16.

#### ORTHOTOMUS SEPIUM CONCINNUS Riley

*Orthotomus sepium concinnus* RILEY, Proc. Biol. Soc. Washington, vol. 40, 1927, p. 96 (Sipora Island).

*Orthotomus sepium ochrommatus?* CHASEN and KLOSS, Ibis, 1926, p. 292.

Eight males and six females, Sipora; three males, three females, and five unsexed birds, Siberut.

Judging by the few adult males from Siberut, the Sipora and Siberut birds belong to the same form. Both series agree in being lighter, purer gray above, with the head and throat lighter cinnamon than *Orthotomus sepium ochrommatus* Oberholser, of the Pagi Islands. *Orthotomus sepium baesus* Oberholser, of Nias Island, is darker and nearer *cineraceus* than the Pagi Island form and need not be considered here.

The series from the various Mentawi Islands measure as follows:

Eight males, Sipora: Wing, 43.5-50 (47.2); culmen, 14.5-15.5 (14.9).

Three males, Siberut: Wing, 46-51 (48.7); culmen, 15-15.5 (15.2).

Four males, Pagi Islands (North Pagi, 3; South Pagi, 1): Wing, 50-52 (50); culmen, 14.5-15.5 (15).

Six females, Sipora: Wing, 44-47.5 (45.9); culmen, 14-15 (14.4).

Three females, Siberut: Wing, 43-46.5 (45); culmen, 14.5-15 (14.8).

One female, North Pagi Island: Wing, 48.5; culmen, 14.

#### LANIUS TIGRINUS Drapiez

*Lanius tigrinus* DRAPIEZ, Dict. Class. Hist. Nat., vol. 13, 1828, p. 523 (Java).

*Lanius tigrinus* CHASEN and KLOSS, Ibis, 1926, p. 292.

A series of nine immature birds from Siberut and three from Sipora.

The series from Siberut were taken September 18-October 2; those from Sipora October 29-November 3.

The United States National Museum possesses two immature examples from Simalur Island, November 25 and December 12, and three from Tana Bala, Batu Islands, February 6-13.

<sup>34</sup> Marked as a female, but probably a male.

<sup>35</sup> Marked male, but probably a female.

## CORVUS ENCA ENCA (Horsfield)

*Fregilus enca* HORSFIELD, Trans. Linn. Soc. London, vol. 13, 1821, p. 164 (Java).

*Corvus enca enca* CHASEN and KLOSS, Ibis, 1926, p. 293.

Four males and five females, Sipora; two females, Siberut.

The above material has been compared with a male and female from Java and I can find no difference between them. The United States National Museum collection contains specimens of *Corvus enca compiler* Richmond from Simalur and Nias and Büttikofer<sup>36</sup> records *Corvus macrorhynchus* from the latter island also.

## DICRUOPSIS BORNEENSIS VIRIDINITENS Salvadori

*Dicruopsis viridinitens* SALVADORI, Ann. Mus. Civ. Storia Nat. Genova, ser. 2, vol. 14, 1894, p. 593 (Sipora Island).

*Dicrurus borneensis viridinitens* CHASEN and KLOSS, Ibis, 1926, p. 293.

Six males, three females, and one unsexed bird, Siberut; five males, four females, and one without sex, Sipora.

A series of two males, five females, and one unsexed example collected on South Pagi Island by Dr. W. L. Abbott, does not differ essentially from the Siberut-Sipora series. Otherwise I have nothing to add to Chasen and Kloss's remarks.

## DICRURUS LEUCOGENIS PERIOPHTHALMICUS (Salvadori)

*Euchanga periophthalmica* SALVADORI, Ann. Mus. Civ. Storia Nat. Genova, ser. 2, vol. 14, 1894, p. 594 (Si Oban, Sipora).

*Dicrurus leucogenis diporus* OBERHOLSER, Smith. Misc. Coll., vol. 60, no. 7, 1912, p. 15 (North Pagi Id.).

Five males, five females, and one skin without sex, Sipora.

This series has been compared with the type of *D. l. diporus* and found to be practically identical, both as to coloration and size. The latter was originally compared with *D. l. leucogenis* and *D. l. stigmatops*, but not with *D. l. periophthalmicus*, of which there were probably no specimens in this country at that time.

## DICRURUS LEUCOGENIS SIBERU Chasen and Kloss

*Dicrurus leucogenis siberu* CHASEN and KLOSS, Ibis, 1926, p. 294 (Siberut Island).

Eight males and three females, Siberut.

The above series compared with *D. l. periophthalmicus* averages darker above and below; the white of the cheeks is somewhat reduced in size; the size is, however, hardly less.

<sup>36</sup> Notes Leyden Mus., vol. 18, 1896, p. 189.

**ORIOIUS CHINENSIS SIPORA Chasen and Kloss**

*Oriolus chinensis sipora* CHASEN and KLOSS, Ibis, 1926, p. 294 (Sipora Island).

Five adult males, six adult females, and one immature female, Sipora.

The only difference I can detect between *O. c richmondi* of the Pagi Islands and the present form is in the color of the wings. In *sipora* the inner primaries are more extensively margined with grayish or yellowish-white on the outer web and at the tip and the inner secondaries and tertials have the yellow outer web at the tip more extensive. These differences seem quite constant. There appears to be little or no difference in size between the two series.

Five males from Sipora measure: Wing, 149.5–154.5 (151.4); culmen, 32–33.5 (32.5).

Six males from North Pagi (5) and South Pagi (1) measure: Wing, 145.5–152.5 (150.7); culmen, 31.5–33 (32.6).

Six females from Sipora: Wing, 146.5–152 (149); culmen, 31–33 (31.9).

Three females from South Pagi: Wing, 141–152 (147.7); culmen, 32–34.5 (32.8).

**ORIOIUS CHINENSIS SIBERU Chasen and Kloss**

*Oriolus chinensis siberu* CHASEN and KLOSS, Ibis, 1926, p. 294 (Siberut Island).

Five adult males, one immature male, four adult females, one immature female, and one without sex, Siberut.

More greenish on the back than in *sipora* with less extensive white margins to the inner primaries and less yellow on the outer web of the inner secondaries and the tertiaries. In the latter character resembling *richmondi*, but the back more greenish. There appears to be little or no difference in size between *sipora* and *siberu*, except the latter on the average has a longer bill.

Five males from Siberut measure, wing, 146–156 (151.7); culmen, 33–34 (33.5), and four females; wing, 141.5–151 (145.4); culmen, 31.5–33.5 (32.4).

*Oriolus chinensis mundus* of Simalur Island is a very distinct form with no speculum in the wing and the yellow on the tertials much reduced; the bill longer than any other Barussan Island form. It needs no comparison with the Mentawi forms.

**ORIOIUS XANTHONOTUS MENTAWI Chasen and Kloss**

*Oriolus xanthonotus mentawi* CHASEN and KLOSS, Ibis, 1926, p. 295 (Siberut Island).

Four adult males and one adult female, Siberut; one adult and one immature male, Sipora.

The only adult female submitted is certainly darker than the mainland bird. An adult female in the United States National Museum from Java (the type locality of *xanthonotus*) has the top of the head and nape deep mouse gray, the feathers with a rather broad central sooty black stripe; the mantle lemon chrome, the feathers streaked centrally with pyrite yellow; rump lemon chrome. This is quite different from the warbler green back of the mainland and Mentawi bird; and the top of the head is much darker than in even the Mentawi bird. Whether these differences would hold in a larger series I do not know.

The single adult male from Sipora is less heavily streaked below than the Siberut males, but I believe this is an individual difference. One of the Siberut males has the breast and belly strongly tinged with citron yellow.

#### AGROPSAR STURNINUS (Pallas)

*Gracula sturnina* PALLAS, Reise. Russ. Reichs., vol. 3, 1776, p. 695 (Dauria).  
*Sturnia sturnina* CHASEN and KLOSS, Ibis, 1926, p. 295.

One immature female, Sipora, October 23.

The United States National Museum possesses an immature female from Simalur Island, December 11.

#### GRACULA JAVANA BATUENSIS Finsch

*Gracula batuensis* FINSCH, Notes Leyden Mus., vol. 21, 1899, p. 14 (Pulo Tello, Batu Islands).

*Gracula javana enganensis* CHASEN and KLOSS, Ibis, 1926, p. 295.

Four males and six females, Siberut; six males, six females, and one unsexed, Sipora.

The United States National Museum possesses one adult male and two adult females from North Pagi Island and three adult males and two adult females from South Pagi Island. The series from Siberut, Sipora, and the Pagi Islands agree in size and color and undoubtedly represent but a single form. Comparing the Mentawi series with one consisting of two adult males and seven adult females from Engano Island, I find the former to be slightly larger, with a considerably longer and heavier bill. Undoubtedly *Gracula javana enganensis* is restricted to Engano Island.

*Gracula robusta* of Nias is a larger bird with a much larger and heavier bill and the line of feathers on the sides of the neck, separating the bare space below the eyes from the occipital lappets, is broader and differently shaped from the forms grouped under *Gracula javana*. In *Gracula robusta* the line of feathers just referred to is broader above, while in the forms of *Gracula javana* it is

narrower above, broader below, and much narrower in width. In my opinion *Gracula robusta* is a well-marked species with its own insular subspecies.

The forms I am prepared to recognize from the islands off the west coast of Sumatra are as follows:

- (1) *Gracula robusta robusta* Salvadori. Size large; culmen, 34-38 (35.5), Nias Island and Pulo Babi.
- (2) *Gracula robusta opheltochlora* Oberholser. Somewhat smaller; culmen, 32.5-34 (33.5). Banjak Islands (Pulo Tuangku).
- (3) *Gracula javana miotera* Oberholser. Somewhat like *enganensis* but slightly larger; culmen, 28-30 (29.2). Simalur Island.
- (4) *Gracula javana batuensis* Finsch. Larger than either *miotera* or *enganensis*, especially the bill; culmen, 30-34 (32).<sup>37</sup> Batu Islands and Mentawi Islands (Siberut, Sipora, North and South Pagi).
- (5) *Gracula javana enganensis* Salvadori. Somewhat smaller than *batuensis* the bill pronouncedly so; culmen, 25-30 (28).<sup>38</sup>

#### LAMPROCORAX PANAYENSIS PACHISTORHINUS Oberholser

*Lamprocorax chalybeus pachistorhinus* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 17 (South Pagi Island).

*Aplonis panayensis altirostris* CHASEN and KLOSS, Ibis, 1926, p. 296.

Seven males and three females, Siberut; two males and four females, Sipora.

The United States National Museum possesses seven adult males and three adult females from South Pagi Island. The birds from Siberut, Sipora, and South Pagi Island apparently belong to one form, but it is not the same as that from Nias Island (*altirostris*). The Mentawi Island subspecies has a larger, heavier bill and is slightly less glossy.

The specimens of this species in the United States National Museum from the islands off the west coast of Sumatra fall naturally into three recognizable forms, to which is to be added a form described from Pulo Pinie not here represented. They are as follows:

- (1) *Lamprocorax panayensis altirostris*.

*Calornis altirostris* SALVADORI, Ann. Mus. Civ. Stor. Nat. Gen., ser. 2, vol. 4, 1887, p. 553, pl. 9, fig. 1 (Nias).

*Lamprocorax chalybeus rhadinorhynchus* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 17 (Simalur).

*Lamprocorax panayensis nesodramus* OBERHOLSER, Journ. Washington Acad. Sci., vol. 16, 1926, p. 516 (Pulo Babi).

The Museum has specimens from Nias, Simalur, and Pulo Babi.

<sup>37</sup> Twenty-nine specimens.

<sup>38</sup> Eight specimens.

This form is slightly smaller with a smaller bill than that from the Mentawi Islands. The birds from Nias, Simalur, and Pulo Babi measure as follows:

NIAS. Three adult males: Wing, 96-103 (99); tail, 62-62.5 (63.8); culmen, 19. Four adult females: Wing, 97-104 (100); tail, 56-65.5 (60); culmen, 17-18 (17.6).

SIMALUR. One adult male (type of *rhadinorhynchus*): Wing, 101.5; tail, 60; culmen, 17.5. One adult female: Wing, 102.5; tail, 62; culmen, 17.5.

PULO BABI. Two adult females: Wing, 102-104; tail, 62.5-64; culmen, 17-18.

(2) *Lamprocorax panayensis pachistorhinus* Oberholser.

Somewhat larger than *altirostris*, but less glossy and with a larger bill. Apparently confined to the Mentawi Islands.

Fourteen males measure: Wing, 102-113 (106.3); tail, 62-69.5 (65); culmen, 18.5-21.5 (19.8); and ten females, wing, 100-105 (102.4); tail, 61-67.5 (63); culmen, 17.5-20.5 (19.3).

(3) *Lamprocorax panayensis enganensis*.

*Colurnis enganensis* SALVADORI, Ann. Mus. Civ. Storia Nat. Gen., ser. 2, vol. 12, 1892, p. 137 (Engano).

Similar to *pachistorhinus*, but with a longer wing and tail; the bill smaller and weaker.

Five adult males measure: Wing, 112-114 (112.7); tail, 70-77 (72.9); culmen, 18-19 (18.3); and three adult females, wing, 105.5-114 (109.5); tail, 67-74.5 (70.5); culmen, 18.5-19 (18.7).

(4) *Lamprocorax panayensis leptorrhynchus*.

*Aplonis panayensis leptorrhynchus* STRESEMANN, Nov. Zool., vol. 20, 1913, p. 377 (Pulo Pini).

Of this form the United States National Museum collection contains no specimens, but from the measurements given by the describer it is as large or larger than *enganensis*. No length of culmen is given, unfortunately. It must be a recognizable form, however, as the measurements would indicate a larger bird than *altirostris* or *pachistorhinus*, and it could not very well be *enganensis*, as the Mentawi form would come in between.

MOTACILLA CINEREA CASPICA (S. G. Gmelin)

*Parus caspicus* S. G. GMELIN, Reise d. Russland, vol. 3, 1774, p. 104, pl. 20, fig. 2 (Enzeli or Enseli, Caspian Sea).

*Motacilla cinerea caspica* CHASEN and KLOSS, Ibis, 1926, p. 296.

One male, one female, and one unsexed bird, Sipora, October 12-21.

**BUDYTES FLAVUS SIMILLIMUS (Hartert)**

*Motacilla flava simillima* HARTERT, Vögel Pal. Fauna, vol. 1, pt. 3, 1905, p. 289 (Kamchatka to Moluccas, etc.); Nov. Zool., vol. 26, 1919, p. 167 (type from Sulu Island).—CHASEN and KLOSS, Ibis, 1926, p. 296.

One female, Siberut, September 20; one female, Sipora, October 11.

The above two specimens are young birds; they agree fairly well with northern Celebes specimens in the same stage of plumage.

**DENDRONANTHUS INDICUS (Gmelin)**

*Motacilla indica* GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 962 (India).

*Dendronanthus indicus* CHASEN and KLOSS, Ibis, 1926, p. 297.

One male and two females, Siberut, September 12–15; two males and five females,<sup>3</sup> Sipora, October 22–November 2.

The United States National Museum possesses specimens from Simalur Island, October 25–November 30; Nias Island, February 20–March 25; Tana Bala, Batu Islands, February 5 and 6.

**CHALCOSTETHA CALCOSTETHA PAGICOLA Oberholser**

*Chalcostetha calcostetha pagicola* OBERHOLSER, Smiths. Mis. Coll., vol. 60, no. 7, 1912, p. 17 (North Pagi Island).

*Chalcostetha calcostetha calcostetha* CHASEN and KLOSS, Ibis, 1926, p. 297 (Sipora).

*Chalcostetha calcostetha siberu* CHASEN and KLOSS, Ibis, 1926, p. 297 (Siberut).

Five males and four females, Sipora; one male and two females, Siberut.

The two females from Siberut are paler than those from Sipora, but a female from North Pagi Island exactly matches them. There is no difference in size. I am inclined to think the deeper color of the Sipora females is due to the fresher condition of the plumage. They were collected in middle or late October, while the Siberut females were collected in middle or late September. One female in the Sipora series, collected October 21, is somewhat worn and is almost, if not quite, as pale as Siberut females. Specimens from Nias and the Batu Islands do not appear to differ from those from the Pagi Islands. If any form is to be named, it would be that from Sipora; but this would divide the habitat of *pagicola*, so I do not believe it advisable to provide a name for it on the material at hand.

Specimens from Simalur Island are larger than *pagicola*, especially the bills. It has been named *Chalcostetha calcostetha heliomarpta* Oberholser.<sup>39</sup>

From the islands off the west coast of Sumatra there are two recognizable forms, judging from the material before me, as follows:

<sup>39</sup> Journ. Washington Acad. Sci., vol. 13, 1923, p. 229.

(1) *Chalcostetha calcostetha heliomarpta* Oberholser. Simalur Island.

(2) *Chalcostetha calcostetha pagicola* Oberholser. Nias Island; Pulo Pinie, Batu Islands; Mentawi Islands (Siberut, Sipora, North and South Pagi Islands).

**AETHOPYGA SIPARAJA PHOTINA Oberholser**

*Aethopyga siparaja photina* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 18 (North Pagi Island).

*Aethopyga siparaja siparaja* CHASEN and KLOSS, Ibis, 1926, p. 297 (Sipora Island).

*Aethopyga siparaja siberu* CHASEN and KLOSS, Ibis, 1926, p. 298 (Siberut Island).

Fifteen males and 14 females, Sipora; 4 males, Siberut.

This race is darker on the average than *A. s. siparaja* of Sumatra.

Three out of the four males from Siberut have the feathers of the rump washed with red, giving an orange effect to this region, but so has one of the males from Sipora and the type of *photina* is identical. I do not see, under the circumstances, any other alternative than to merge *siberu* with *photina*.

After studying and measuring the specimens of this species from Sumatra and the various islands off the west coast of Sumatra, I would reduce the recognizable forms from this region to three, as follows:

(1) *Aethopyga siparaja siparaja* (Raffles).

*Certhia siparaja* RAFFLES, Trans. Linn. Soc. London, vol. 13, 1820, p. 299 (West Sumatra).

*Aethopyga siparaja tinoptila* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 17 (Pulo Sumat, near Simalur Island).

*Aethopyga siparaja melanetra* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 18 (Pulo Lasia).

*Aethopyga siparaja heliophilica* OBERHOLSER, Journ. Washington Acad. Sci., vol. 13, 1923, p. 231 (Pulo Bangkaru, Banjak Islands).

*Range*.—Sumatra, the Malay Peninsula,<sup>40</sup> Simalur Island, Pulo Lasia, and the Banjak Islands.

(2) *Aethopyga siparaja niasensis* HARTERT, Ornith Monatsb., vol. 6, 1898, p. 92 (Nias Island).

A series of seven males are lighter red above than *A. s. siparaja*.

*Range*.—Confined to Nias Island, so far as known.

(3) *Aethopyga siparaja photina* OBERHOLSER, as given above.

*Range*.—Mentawi Islands (Siberut, Sipora, North Pagi, and South Pagi).

<sup>40</sup> The range of this form on the mainland is uncertain and the bird there may prove not to be this form at all.



Allowing for the inequality of the various series, there does not appear to be any appreciable difference in size among the races.

**LEPTOCOMA BRASILIANA HYPOLAMPIS** (Oberholser)

*Cinnyris brasiliانا hypolampis* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 19 (South Pagi Island).

*Leptocoma brasiliانا brasiliانا* CHASEN and KLOSS, Ibis, 1926, p. 298.

Four males and one female, Sipora; one male and three females, Siberut.

There does not seem to be any constant difference between specimens from the two above islands or from the Pagi Islands. Two males from Java and two males from Singapore have noticeably smaller bills. I am prepared to recognize three forms from the islands off the west coast of Sumatra as follows:

(1) *Leptocoma brasiliانا mecynorhyncha* (Oberholser).

Similar to *L. b. brasiliانا* but bill much larger. Culmen 16-15. Simalur Island.

(2) *Leptocoma brasiliانا oenopa* (Oberholser).

Similar to *L. b. mecynorhyncha* but bill smaller, though larger than in *L. b. brasiliانا*, culmen, 14-15.5.

Nias Island.

(3) *Leptocoma brasiliانا hypolampis* (Oberholser).

Top of the head more coppery, less golden, and the rump with less violet wash than in *L. b. oenopa*; there is no difference in size. A poorly marked form hardly worthy of recognition. Mentawi Islands (Siberut, Sipora, North and South Pagi).

**ANTHREPTES MALACENSIS NASAEUS** Oberholser

*Anthreptes malacensis nasaeus* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 20 (Sikakap Strait, Pagi Ids.).

*Anthreptes malacensis malacensis* CHASEN and KLOSS, Ibis, 1926, p. 299.

Nine adult males, four immature males, and four females, Siberut; one adult male, one immature male, and one female, Sipora.

The above material agrees in size and color with the small typical series from the Pagi Islands. The Mentawi Islands form on the average has a longer and heavier bill, and the iridescent purple edges to the feathers of the mantle are more pronounced than in *Anthreptes malacensis malacensis*.

According to the material in the United States National Museum, three forms can be recognized from the islands off the west coast of Sumatra, as follows:

(1) *Anthreptes malacensis pelloptilus* Oberholser.

Bill larger and heavier than *malacensis*; the iridescent purple of the mantle more pronounced. Three males have the culmen, 18.5-19 (18.8). Simalur Island.

(2) *Anthreptes malacensis pollostus* Oberholser.

Hardly different from *malacensis*; appears to have less iridescent purple on the mantle. Not a well-marked form. Culmen, 16-17.5 (16.8), Nias Island.

(3) *Anthreptes malacensis nasaeus* Oberholser.

More iridescent purple on the mantle than in *malacensis* or *pollostus*; bill slightly larger and heavier. Culmen, 17-18.5 (17.7). Mentawi Islands (Siberut, Sipora, North and South Pagi).

**ARACHNOTHERA LONGIROSTRA LONGIROSTRA (Latham)**

*Certhia longirostra* LATHAM, Ind. Orn., vol. 1, 1790, p. 299 (Bengal, Sylhet).

*Arachnothera longirostra exochra* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 19 (South Pagi Island).

*Arachnothera longirostra hypochra* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 19 (North Pagi Island).

*Arachnothera longirostra* CHASEN and KLOSS, Ibis, 1926, p. 299.

Five males, four females, and one unsexed bird, Siberut; ten males, three females, and one without sex, Sipora.

There seems to be little or no difference in size between the series from Siberut and Sipora and that from North and South Pagi Islands, and the difference in color, if any, is negligible. A small series from the mainland, north of Singapore, and two males from east Sumatra seem to agree in size and color with the series from the Mentawi Islands. A few specimens from near Singapore average smaller and represent a different form. It has been named *Arachnothera l. heliocrita* Oberholser.<sup>41</sup>

Three specimens from Pulo Bankaru, Banjak Islands, have longer bills, especially the type. It has been named *Arachnothera longirostra zarhina* Oberholser.<sup>42</sup>

Two specimens from Nias Island are paler than any I have examined and the bills are longer than the average, but not quite as

<sup>41</sup> Journ. Washington Acad. Sci., vol. 13, 1923, p. 227

<sup>42</sup> Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 19.

long as the type of *zarkhina*. It has been named *Arachnothera l. niasensis* van Oort.<sup>43</sup>

There is quite a sexual difference in size, the females having considerably shorter wings and bills, and it is probable that abnormally small birds marked as males may be wrongly sexed.

Seven males (including type of *antelia*) from Tenasserim and Trong, measure: Wing, 67.5-70 (68.6); culmen, 37-41 (38.1).

Two males (including type of *melanchima*) from east Sumatra measure: Wing, 70-71.5 (70.7); culmen, 39-39.5 (39.2).

Five males from Siberut: Wing, 67.5-72.5 (68.9); culmen, 37-41 (39.4).

Ten males from Sipora: Wing, 65-71.5 (68.6); culmen, 35-40 (38.1).

Three males from North Pagi (including type of *hypochra*): Wing, 67.5-70 (68.5); culmen, 38-40 (39).

Four males from South Pagi (including type of *exochra*): Wing, 66-70 (68.5); culmen, 37.5-39.5 (38.4).

Three males from near Singapore (including type of *heliocrita*): Wing, 63-69 (66.8); culmen, 33.5-35.5 (34.7).

Two males, Nias (one marked "female?", but from the measurements is a male): Wing, 68.5-69 (68.7); culmen, 40-42 (41).

Two males, Pulo Bangkaru, Banjak Islands (including type of *zarkhina*): Wing, 68-71 (69.5); culmen, 38.5-44.5 (41.5).

A peculiar circumstance about the above averages (with one or two exceptions) is their remarkable uniformity.

#### ARACHNOTHERA CHRYSOGENYS ISOPEGA Oberholser

*Arachnothera chrysogenys isopega* OBERHOLSER, Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 20 (Pagi Islands).

*Arachnothera chrysogenys* CHASEN and KLOSS, Ibis, 1926, p. 299.

One male, Sipora.

The above specimen is molting. It agrees fairly well with the type of *isopega*, which has a longer wing than any measured from the rest of the range of the species represented in the United States National Museum. The wing in the type of *isopega* measures 96; that of the Sipora specimen, 87, but the latter would have possessed a longer wing had the molt been completed. A female from South Pagi Island also seems to have a longer wing than true *chrysogenys*. I have only examined the three specimens from the Mentawi Islands.

Three male specimens from Tapanuli Bay, west Sumatra, the original series of *Arachnothera chrysogenys cophia* Oberholser, are more yellowish above and below and have slightly shorter wings than *isopega*.

A male and female from Nias Island in the United States National Museum represents the original material of *Arachnothera chrysogenys pleoxantha* Oberholser.<sup>44</sup> The type (the female) is more yellowish

<sup>43</sup> Notes Leyden Mus., vol. 32, no. 4, 1910, p. 195.

<sup>44</sup> Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 20.

above and below than *copha*, but the male is considerably grayer, less yellowish below. Both are rather small and will have to depend upon size for recognition until additional specimens have been examined.

A series of two males and four females from east Sumatra that Doctor Oberholser regards as typical of *A. c. chrysogenys* are more yellowish above and below than the west Sumatran bird, *copha*, and somewhat smaller. I have not examined Javan specimens which Stuart Baker says is the typical *chrysogenys*.

*Arachnothera chrysogenys astilpna* Oberholser<sup>45</sup> and *Arachnothera chrysogenys intensiflava* Stuart Baker<sup>46</sup> were both described from Tenasserim and are probably synonymous; the former name should be used for this form, being the older.

#### DICAEUM CRUENTATUM BATUENSE Richmond

*Dicaeum sumatranum batuense* RICHMOND, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 104 (Pulo Pinie, Batu Islands).

*Dicaeum cruentatum batuense* CHASEN and KLOSS, Ibis, 1926, p. 300.

Five males and one female, Sipora.

The above series agrees with the type of *batuense*. The United States National Museum possesses an immature male of apparently the same form, from South Pagi Island. The chin and throat are neutral gray, with a few scattered white feathers coming in on the chin; the upper parts dark grayish olive, the crown, mantle, and rump with a few black scarlet tipped feathers appearing; otherwise it is like the adult. Already the white band down the center of the lower parts has progressed further forward than in *D. c. sumatranum*.

An adult male, collected by Dr. W. L. Abbott on Nias Island (180,074), apparently of *D. c. sumatranum*, has a somewhat larger bill than *D. c. batuense* and the throat, chin, and foreneck are neutral gray. In *batuense* there is a rather broad band of ivory white extending to and including the chin.

The five males measure: Wing, 44.5-49 (45.8); culmen, 9-10 (9.8). The type of *batuense* measures: Wing, 45.5; culmen, 10. The Nias specimen of *sumatranum*: Wing, 48.5; culmen, 10.5.

#### DICAEUM TRIGONOSTIGMUM PAGENSE Oberholser

*Dicaeum trigonostigmum pagense* OBERHOLSER, Journ. Washington Acad. Sci., vol. 16, 1926, p. 520 (South Pagi Id.).

*Dicaeum trigonostigma* CHASEN and KLOSS, Ibis, 1926, p. 300.

Seven adult males, two immature males, and three females, Siberut; seven adult males and eight females, Sipora.

<sup>45</sup> Journ. Washington Acad. Sci., vol. 13, 1923, p. 227.

<sup>46</sup> Bull. Brit. Orn. Club, vol. 46, 1925, p. 14.

The above series and specimens from South Pagi Island appear to be identical.

The Nias Island form has been named *D. t. lyprum* by Oberholser.<sup>47</sup> With it I would place a male from Pulo Pinie, Batu Islands, which appears to have a somewhat lighter throat.

Simalur Island specimens are larger than those from Nias or the Mentawi Islands and the female is quite different from that of any other form examined. It is darker, and grayer above with very little olive green wash and the rump is only crossed by a narrow band of yellowish citrine; below it is grayer, the breast with only a narrow band of barium yellow down the center. It has been named *Dicaeum trigonostigma antioproctum* Oberholser.<sup>47</sup> *Dicaeum trigonostigma melanthe* Oberholser from Pulo Lasia was evidently founded upon a single male. It agrees with Simalur Island specimens in size; in color it is slightly darker above and on the throat. The differences are so very slight that in my opinion it should be merged with the Simalur form.

Summarizing, I am prepared to recognize three subspecies from the west Sumatra islands as follows:

- (1) *Dicaeum trigonostigmum pagense* Oberholser. Mentawi Islands (Siberut, Sipora, South Pagi).
- (2) *Dicaeum trigonostigmum lyprum* Oberholser. Nias Island and Pulo Pinie, Batu Islands.
- (3) *Dicaeum trigonostigmum antioproctum* Oberholser. Simalur Island and Pulo Lasia.

Outside of the Simalur Island form, which is characterized like so many of the races from this island by superior size, the other two subspecies are not strikingly different in color or size from *D. t. trigonostigmum* of the mainland, and if it were not for their insular habitat would hardly be worthy of recognition. The only differences between the mainland form and those from the islands being the somewhat darker upper parts and the more yellow, less orange wash on the rump of the latter.

*Check list of Mentawi birds*

|  | Siberut | Sipora | North Pagi | South Pagi | Pagi Islands |
|--|---------|--------|------------|------------|--------------|
| Family TRERONIDAE  |         |        |            |            |              |
| 1. <i>Treron curvirostra smicra</i> Oberholser.....      | ×       | ×      | -----      | -----      | -----        |
| 2. <i>Dendrophassa vernans mesochloa</i> Oberholser..... | ×       | ×      | ×          | ×          | -----        |
| 3. <i>Muscadivores aeneus vicinus</i> Riley.....         | ×       | ×      | ×          | ×          | -----        |
| 4. <i>Myristicivora bicolor bicolor</i> (Scopoli).....   | -----   | ×      | -----      | -----      | ×            |

<sup>47</sup> Smiths. Misc. Coll., vol. 60, no. 7, 1912, p. 21.

## Check list of Mentawi birds—Continued

|  | Siberut | Sipora | North Pagi | South Pagi | Pagi Islands |
|--|---------|--------|------------|------------|--------------|
| Family COLUMBIDAE  |         |        |            |            |              |
| 5. <i>Columba phasma</i> Richmond                        |         |        |            | ×          |              |
| 6. <i>Macropygia emiliana elassa</i> Oberholser          | ×       | ×      | ×          | ×          |              |
| 7. <i>Chalcophaps indica indica</i> (Linnaeus)           | ×       |        | ×          |            |              |
| Family RALLIDAE  |         |        |            |            |              |
| 8. <i>Rallina fasciata</i> (Raffles)                     |         | ×      |            |            |              |
| 9. <i>Amaurornis phoenicura cleptea</i> Oberholser       | ×       | ×      |            |            | ×            |
| Family APHRIZIDAE  |         |        |            |            |              |
| 10. <i>Arenaria interpres interpres</i> (Linnaeus)       |         | ×      |            |            |              |
| Family CHARADRIIDAE                                      |         |        |            |            |              |
| 11. <i>Pluvialis dominicus fulvus</i> (Gmelin)           | ×       | ×      |            |            |              |
| 12. <i>Charadrius leschenaultii</i> Lesson               |         | ×      |            |            |              |
| Family SCOLOPACIDAE                                      |         |        |            |            |              |
| 13. <i>Numenius phaeopus phaeopus</i> (Linnaeus)         | ×       | ×      |            |            |              |
| 14. <i>Actitis hypoleucos</i> (Linnaeus)                 |         |        |            |            | ×            |
| 15. <i>Capella stenura</i> (Bonaparte)                   |         | ×      |            |            | ×            |
| Family GLAREOLIDAE                                       |         |        |            |            |              |
| 16. <i>Glareola maldivarum</i> Forster                   |         | ×      |            |            |              |
| Family ARDEIDAE  |         |        |            |            |              |
| 17. <i>Typhon sumatrana sumatrana</i> (Raffles)          |         |        |            |            | ×            |
| 18. <i>Hemigarzetta eulophotes</i> (Swinhoe)             |         | ×      |            |            |              |
| 19. <i>Demigretta sacra sacra</i> (Gmelin)               |         | ×      |            |            | ×            |
| 20. <i>Butorides javanicus sipora</i> Chasen and Kloss   | ×       | ×      |            |            |              |
| 21. <i>Butorides javanicus actophilus</i> Oberholser     |         |        | ×          |            |              |
| Family FALCONIDAE  |         |        |            |            |              |
| 22. <i>Spilornis elgini sipora</i> Chasen and Kloss      |         | ×      |            |            |              |
| 23. <i>Spilornis</i> species                             |         |        |            |            | ×            |
| 24. <i>Cuncuma leucogaster</i> (Gmelin)                  |         | ×      |            |            | ×            |
| 25. <i>Pernis ptilorhynchus ptilorhynchus</i> (Temminck) | ×       |        |            |            |              |
| 26. <i>Haliastur indus intermedius</i> Gurney            |         |        |            |            | ×            |
| 27. <i>Spizaetus alboniger</i> (Blyth)                   |         |        | ×          |            |              |
| Family BUBONIDAE   |         |        |            |            |              |
| 28. <i>Otus bakkamoena mentawi</i> Chasen and Kloss      | ×       | ×      |            |            |              |
| Family PSITTACIDAE                                       |         |        |            |            |              |
| 29. <i>Psittinus cyanurus pontius</i> Oberholser         | ×       | ×      |            | ×          |              |
| 30. <i>Loriculus galgulus galgulus</i> (Linnaeus)        | ×       | ×      |            |            | ×            |

## Check list of Mentawi birds—Continued

|   | Siberut | Sipora | North Pagi | South Pagi | Pagi Islands |
|---|---------|--------|------------|------------|--------------|
| Family CORACIIDAE   |         |        |            |            |              |
| 31. <i>Eurystomus orientalis calonyx</i> Sharpe.....                  | -----   | ×      | -----      | -----      | -----        |
| Family ALCEDINIDAE  |         |        |            |            |              |
| 32. <i>Rhamphalcyon capensis isoptera</i> Oberholser.....             | ×       | ×      | ×          | ×          | -----        |
| 33. <i>Alcedo atthis bengalensis</i> Gmelin.....                      | ×       | -----  | -----      | -----      | -----        |
| 34. <i>Alcedo meninting proxima</i> Richmond.....                     | -----   | ×      | ×          | ×          | -----        |
| 35. <i>Ceyx rufidorsus rufidorsus</i> Strickland.....                 | ×       | ×      | -----      | -----      | -----        |
| 36. <i>Ceyx dillwynni</i> Sharpe.....                                 | -----   | ×      | -----      | -----      | -----        |
| 37. <i>Ceyx</i> species.....  | -----   | -----  | -----      | -----      | ×            |
| 38. <i>Entomothera coromanda pagana</i> Oberholser.....               | ×       | ×      | ×          | -----      | -----        |
| 39. <i>Sauropatis chloris chloroptera</i> Oberholser.....             | ×       | -----  | ×          | -----      | -----        |
| 40. <i>Halcyon pilcata</i> (Boddaert).....                            | ×       | ×      | ×          | ×          | -----        |
| 41. <i>Halcyon concreta</i> (Temminck).....                           | ×       | -----  | -----      | -----      | -----        |
| Family BUCEROTIDAE  |         |        |            |            |              |
| 42. <i>Hydrocissa convexa convexa</i> (Temminck).....                 | ×       | ×      | ×          | ×          | -----        |
| Family MEROPIDAE  |         |        |            |            |              |
| 43. <i>Merops philippinus javanicus</i> Horsfield.....                | ×       | -----  | -----      | -----      | -----        |
| Family MICROPODIDAE   |         |        |            |            |              |
| 44. <i>Collocalia vestita aerophila</i> Oberholser.....               | -----   | ×      | -----      | -----      | -----        |
| 45. <i>Collocalia linchi oberholseri</i> Stresemann.....              | -----   | ×      | ×          | -----      | -----        |
| Family HEMIPROCINIDAE   |         |        |            |            |              |
| 46. <i>Hemiprocne longipennis thoa</i> Oberholser <sup>48</sup> ..... | -----   | -----  | -----      | ×          | -----        |
| 47. <i>Hemiprocne comata comata</i> (Temminck).....                   | ×       | -----  | ×          | -----      | -----        |
| Family CUCULIDAE  |         |        |            |            |              |
| 48. <i>Hierococcyx fugax</i> subspecies?.....                         | ×       | -----  | -----      | -----      | -----        |
| 49. <i>Cacomantis merulinus threnodes</i> Cabanis and Heine.....      | ×       | -----  | -----      | -----      | -----        |
| 50. <i>Eudynamis scolopacea</i> subspecies.....                       | -----   | -----  | -----      | -----      | ×            |
| 51. <i>Chalcococcyx xanthorhynchus</i> (Horsfield).....               | -----   | ×      | -----      | -----      | -----        |
| 52. <i>Centropus sinensis bubutus</i> Horsfield.....                  | ×       | -----  | -----      | -----      | -----        |
| 53. <i>Urococcyx aeneicauda</i> (J. and E. Verreaux).....             | ×       | ×      | ×          | ×          | -----        |
| Family EURYLAIMIDAE   |         |        |            |            |              |
| 54. <i>Calyptomena viridis siberu</i> Chasen and Kloss.....           | ×       | -----  | ×          | ×          | -----        |

<sup>48</sup> On the islands off the west coast of Sumatra three forms of *Hemiprocne longipennis* occur:

(1) *Hemiprocne longipennis perlonga* (Richmond) on Simalur. Wings long (172-184), head and mantle shining bronzy green, gray of the rump more or less restricted.

(2) *Hemiprocne longipennis ocyptera* Oberholser on Nias. Wing shorter (163-175) head and mantle less bronzy than *H. l. perlonga*, gray of rump more extensive.

(3) *Hemiprocne longipennis thoa* Oberholser on the Batu Islands, South Pagi, and probably the intervening islands. Wing longer than *H. l. ocyptera* (173-180), about the same size as *H. l. perlonga*, but the latter more bronzy green on head and mantle; the rump less extensively gray.

Of *Hemiprocne longipennis harterti* Stresemann (type locality, Deli, Sumatra), I have not examined enough specimens from Sumatra to comment upon its validity, but specimens from Trengganu, Peninsular Siam, average smaller, (wing, 154-164), are more bronzy on the mantle and head, and are darker below than the Nias Island form.

## Check list of Mentawi birds—Continued

|   | Siberut | Sipora | North Pagi | South Pagi | Pagi Islands |
|---|---------|--------|------------|------------|--------------|
| Family PITTIDAE   |         |        |            |            |              |
| 55. <i>Pitta moluccensis moluccensis</i> (P. L. S. Müller)----- |         | ×      |            |            |              |
| Family HIRUNDINIDAE   |         |        |            |            |              |
| 56. <i>Hirundo rustica gutturalis</i> Scopoli-----              | ×       |        |            |            |              |
| Family MUSCICAPIDAE   |         |        |            |            |              |
| 57. <i>Arizelomyia latirostris latirostris</i> (Raffles)        | ×       |        |            |            |              |
| 58. <i>Muscitrea grisola vandepolli</i> (Finsch)-----           | ×       |        |            | ×          |              |
| 59. <i>Hypothymis azurea leucophila</i> Oberholser-----         | ×       | ×      | ×          | ×          |              |
| 60. <i>Culicicapa ceylonensis amphiala</i> Oberholser-----      | ×       |        | ×          |            |              |
| Family CAMPEPHAGIDAE  |         |        |            |            |              |
| 61. <i>Graucalus sumatrensis crissalis</i> Salvadori-----       | ×       | ×      | ×          | ×          |              |
| 62. <i>Volocivora culminata culminata</i> (A. Hay)-----         | ×       |        |            |            |              |
| Family IRENIDAE   |         |        |            |            |              |
| 63. <i>Irena puella crinigera</i> Sharpe-----                   | ×       | ×      |            | ×          |              |
| Family PYCNONOTIDAE   |         |        |            |            |              |
| 64. <i>Brachypodius atriceps chrysophorus</i> (Oberholser)----- | ×       | ×      |            | ×          |              |
| 65. <i>Microtarsus melanoleucos proximus</i> Riley-----         | ×       |        |            |            |              |
| 66. <i>Pycnonotus plumosus porphyreus</i> Oberholser-----       | ×       | ×      | ×          | ×          |              |
| Family TURDIDAE   |         |        |            |            |              |
| 67. <i>Copsychus saularis pagiensis</i> Richmond-----           | ×       | ×      | ×          |            |              |
| 68. <i>Copsychus saularis</i> subspecies?-----                  | ×       |        |            |            |              |
| 69. <i>Kittacincla melanura</i> Salvadori-----                  | ×       | ×      | ×          | ×          |              |
| Family SYLVIIDAE  |         |        |            |            |              |
| 70. <i>Orthotomus sepium ochrommatus</i> Oberholser-----        |         |        | ×          | ×          |              |
| 71. <i>Orthotomus sepium concinnus</i> Riley-----               | ×       | ×      |            |            |              |
| Family LANIIDAE   |         |        |            |            |              |
| 72. <i>Lanius tigrinus</i> Drapiez-----                         | ×       | ×      |            |            |              |
| Family CORVIDAE   |         |        |            |            |              |
| 73. <i>Corvus enca enca</i> (Horsfield)-----                    | ×       | ×      |            |            |              |



|  | Siberut | Sipora | North Pagi | South Pagi | Pagi Islands |
|--|---------|--------|------------|------------|--------------|
| Family DICRURIDAE  |         |        |            |            |              |
| 74. <i>Dicruopsis borneensis viridiuitens</i> Salvadori.....     | ×       | ×      | ×          | ×          | -----        |
| 75. <i>Dicurus leucogenis periophthalmicus</i> (Salvadori).....  | -----   | ×      | ×          | ×          | -----        |
| 76. <i>Dicurus leucogenis siberu</i> Chasen and Kloss.....       | ×       | -----  | -----      | -----      | -----        |
| Family ORIOLIDAE   |         |        |            |            |              |
| 77. <i>Oriolus chinensis sipora</i> Chasen and Kloss.....        | -----   | ×      | -----      | -----      | -----        |
| 78. <i>Oriolus chinensis siberu</i> Chasen and Kloss.....        | ×       | -----  | -----      | -----      | -----        |
| 79. <i>Oriolus chinensis richmondi</i> Oberholser.....           | -----   | -----  | ×          | ×          | -----        |
| 80. <i>Oriolus xanthonotus mentawi</i> Chasen and Kloss.....     | ×       | ×      | -----      | -----      | -----        |
| Family STURNIDAE   |         |        |            |            |              |
| 81. <i>Agropsar sturninus</i> (Pallas).....                      | -----   | ×      | -----      | -----      | -----        |
| Family GRACULIDAE  |         |        |            |            |              |
| 82. <i>Gracula javana batuensis</i> Finsch.....                  | ×       | ×      | -----      | ×          | -----        |
| 83. <i>Lamprocorax panayensis pachistorhinus</i> Oberholser..... | ×       | ×      | -----      | ×          | -----        |
| Family MOTACILLIDAE  |         |        |            |            |              |
| 84. <i>Motacilla cinerea caspica</i> (S. G. Gmelin).....         | -----   | ×      | -----      | -----      | -----        |
| 85. <i>Budytes flavus simillimus</i> (Hartert).....              | ×       | ×      | -----      | -----      | -----        |
| 86. <i>Dendronanthus indicus</i> (Gmelin).....                   | ×       | ×      | -----      | -----      | -----        |
| Family NECTARINIIDAE   |         |        |            |            |              |
| 87. <i>Chalcostetha calcostetha pagicola</i> Oberholser.....     | ×       | ×      | ×          | ×          | -----        |
| 88. <i>Aethopyga siparaja photina</i> Oberholser.....            | ×       | ×      | ×          | ×          | -----        |
| 89. <i>Cyrtostomus ornatus</i> subspecies <sup>49</sup> ?.....   | -----   | -----  | -----      | -----      | ×            |
| 90. <i>Leptocoma brasiliana hypolampis</i> (Oberholser).....     | ×       | ×      | ×          | ×          | -----        |
| 91. <i>Anthreptes malacensis nasacus</i> Oberholser.....         | ×       | ×      | ×          | ×          | -----        |
| 92. <i>Arachnothera longirostra longirostra</i> (Latham).....    | ×       | ×      | ×          | ×          | -----        |
| 93. <i>Arachnothera chrysogcnys isopca</i> Oberholser.....       | -----   | ×      | -----      | ×          | -----        |
| Family DICAIEIDAE  |         |        |            |            |              |
| 94. <i>Dicaeum cruentatum batuense</i> Richmond.....             | -----   | ×      | -----      | ×          | -----        |
| 95. <i>Dicaeum trigonostigmum pagense</i> Oberholser.....        | ×       | ×      | -----      | ×          | -----        |

<sup>49</sup> Chasen and Kloss, Ibis, 1926, p. 305, report this for the Pagi Islands under the name *Leptocoma jugularis ornata*. It can hardly be *ornata* (type locality Java), however. Doctor Abbott did not obtain it in the Pagi Islands



# A GENERIC REVISION OF THE FOSSORIAL WASPS OF THE TRIBES STIZINI AND BEMBICINI, WITH NOTES AND DESCRIPTIONS OF NEW SPECIES

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## INTRODUCTION

The wasps comprising the subfamily, Bembicinae, as that subfamily is herein understood, have always been regarded by authorities on the Hymenoptera as forming two well-defined groups, the tribes *Stizini* and *Bembicini* of the present paper, but the taxonomic position assigned to the two groups within the family or superfamily (Sphecidae or Sphecoidea) by the various authorities has not been uniform. Some, as for example, Ashmead, who, in his scheme of classification, attached great importance to the number of tibial spurs on the second leg, separated these two groups widely; but others, as Cresson, Fox, Kohl, and Rohwer, have considered them closely related and as forming subdivisions of a larger group, although these authorities differ from one another as to the rank these subdivisions should be given. In accepting the subfamily referred to above I am following the classification adopted by J. H. Comstock in his work, *An Introduction to Entomology*, published in 1924.

The genus *Sphecius*, which was long included in the tribe, *Stizini*, does not belong there, as Rohwer has pointed out.<sup>1</sup> Consequently that genus is not considered in this revision.

In a preceding paper,<sup>2</sup> in which I undertook the revision of the *Bembicini* for North America north of Mexico, it was shown that within that region this tribe is represented by the following genera: *Bembix* Fabricius, *Microbembex* Patton, *Bicyrtes* Latreille (= *Bembidula* Burmeister), *Steniolia* Say, *Stictia* Illiger, and *Stictiella* Parker. Wasps included in the last two genera, *Stictia* and *Stictiella*, had up to the time of the publication of that paper been included in the genus *Monedula* as that genus was understood by Handlirsch,

<sup>1</sup> Proc. U. S. Nat. Mus., vol. 59, 1921, p. 403.

<sup>2</sup> Idem, vol. 52, 1917, pp. 1-155.

Kohl, and others. In that paper I pointed out, as Fox had done before me, that the generic name *Monedula* as applied to wasps must be dropped because of its preoccupation in another field, and that its place in Hymenoptera should be filled by the generic term *Stictia* Illiger. *Vespa signata* Linnaeus was at that time designated as the type of the genus *Stictia*.

I am fully aware of the difficulties that result from the breaking up of an old and long-established genus, such as the genus *Monedula*, into a number of new genera. But when an old genus, as is true in this case, embraces groups of species that possess characters rendering them just as distinct from one another as these groups are individually distinct from other long-recognized genera in the tribe, there is nothing left to do but to give these groups generic rank if our treatment of the tribe is to be at all consistent. That the genus *Monedula*, as understood by Handlirsch and others, was made up of such groups was pointed out in my previous paper. One of these groups is embraced in the genus *Stictia* Illiger, typified by *Vespa signata* Linnaeus, and to a second group the name *Stictiella* was given with *Monedula formosa* Cresson designated as the type. For a third group Burmeister's subgeneric term *Hemidula* was proposed with *Monedula singularis* Taschenberg as the type of this genus. Among the remaining described species not included in the three genera named above, I distinguish four additional groups represented by the following species: *Monedula vulpina* Handlirsch, *Monedula chilensis* Eschscholz, *Monedula gravida* Handlirsch, and *Monedula magnifica* Perty, each of which species is made the type of a new genus. To this list of new genera I have added another based upon a new species described in this paper under the name *Selman angustus*.

Inasmuch as I have not seen a specimen of *Monedula singularis* Taschenberg and find myself unable to determine from the available descriptions of this species just what generic characters it exhibits, it is possible that one of the new genera proposed herein may prove to be a synonym of *Hemidula* Burmeister. But from data furnished me by Dr. H. Bischoff, who at my request kindly examined a female of this species in the museum at Berlin, I learn that the mandibles are edentate, a character possessed in this tribe only by members of the genus *Microbembea*, to which genus *Monedula singularis* certainly does not belong. The uncertainty attached to the taxonomic position of this species will doubtless remain until representatives of both sexes of the species shall have been obtained.

In making this generic revision of the *Bembicini* I have studied with some care the various characters that have been regarded as of generic value in this tribe. Of these I have found the make-up of the maxillary and labial palpi of less value than that generally

assigned to this feature. My examination of these structures in the several genera was not extensive enough to warrant the drawing of broad conclusions, but it was carried far enough to show that in the genus *Bembia*, in which the typical numbers are four segments for the maxillary and two for the labial palpus, the variation in the number of segments in the palpi of some species is such as to lessen the value of these structures for generic purposes. Variation in respect to the number of segments in the palpi was also found in some species of *Steniolia* and *Microbembex*, but the number of individuals examined in each genus was too small to warrant any other statement than that variation does occur. In those genera in which the typical number of segments for the maxillary palpus is six and for the labial four, I did not find variation in the limited number of individuals examined. Since these numbers, however, are regarded as indicating primitive conditions, this lack of variation is readily explained. It was this search for variation in the mouth parts that led to the discovery that the number of segments in the palpi of *Monediula chilensis* Eschscholz is five for the maxillary and three for the labial instead of six and four as had heretofore been supposed.

Since in this tribe (*Bembicini*) the ocelli are much distorted or are reduced to cicatrices, I have found the anterior ocellus providing one of the most reliable characters on which to separate the tribe into genera. Although I have found within a genus some variation with regard to the extent to which the reduction or distortion of the anterior ocellus has been carried, I have found no variation in the form which that reduction shows or to which the reduction is tending. Another character in which I have found little or no variation within a genus is the pattern of the spatha of the male genitalia. With the exception of *Therapon* and *Trichostictia*, in which genera the spatha is almost identical in form, each of the other genera has its own peculiar form of the spatha. I have refrained from using this character in my keys for distinguishing the genera since there is no corresponding character in the female, but for all that, it is a character that must be taken into consideration. In addition to the characters cited above, I have made use of the pubescence of the eyes, the form of the dorsal border of the clypeus, and of certain differences in the venation of the wings.

In the accompanying table I have attempted to show my conception of the relationship existing among the several genera included in this revision. I have not, however, included in the table the genus *Hemidula*, for the simple reason that I have had no opportunity to study a single specimen of *Monedula singularis* Taschenberg.

The difficulty met in an attempt to show exact relationships among genera by a linear arrangement becomes apparent at once. If, as is generally conceded, the presence of unimpaired ocelli, labial palpi

of four segments and maxillary palpi of six segments, and three spines on the eighth sternite of the male indicate primitive conditions in this group, then the first three genera included in the table certainly belong together and are more closely related to one another than to any other of the genera considered. The other genera have become specialized along one or more of the three lines indicated above, and by selecting one of these three lines of specialization on which to base the main divisions we get a different grouping of the genera from that which would have been obtained had we selected either of the other two. It is my opinion that by making the variation in the form and extent of the reduction of the anterior ocellus the main point of departure the relationship existing among the several genera can best be brought out when a simple linear arrangement is employed. I have used such an arrangement in the table submitted.



With each genus of the tribe *Bembicini* I am presenting a key to the species of the genus, including in the key only such species as I have had an opportunity to study from mounted specimens. In a great many cases I have had only one specimen of a species from which to derive characters to be used in separating that species from other species of the genus included in the key. Any key so constructed must of necessity prove faulty, since color characters, on which we are so often forced to rely in separating species, often vary widely within the species, and since, in the case of some species, even structural differences are not constant. Defects arising out of these difficulties will be found most abundant in the key to the species of the genus *Bembix*, wherein I have disregarded geographical distribution on the theory that if two wasps belong to different species there should be some way of distinguishing one from the other aside from their geographical origin. I am fully aware of the imperfections in these keys, but I am submitting them as the best I could devise from the material available. I, therefore, ask of those who may attempt to make use of them a full measure of their generous sympathy, and to those who may find them intolerably bad I shall look with expectancy for a speedy publication of something better.

To the following institutions and to those connected with them having charge of their collections of Bembicine wasps I desire to acknowledge my indebtedness for the loan of material and for suggestions and assistance in the preparation of this paper: The California Academy of Sciences, Carnegie Museum in Pittsburgh, Cornell University, Massachusetts Agricultural College, Academy of Natural Sciences of Philadelphia, Zoologisches Museum der Universität, Berlin, American Museum of Natural History, Kansas University, and the United States National Museum.

Throughout the studies connected with the preparation of this manuscript I have received helpful suggestions from Mr. S. A. Rohwer, of the Bureau of Entomology, United States Department of Agriculture, and wish to express my gratitude to him. I also wish to give credit to Miss Eleanor T. Armstrong, of the same bureau, for the preparation of most of the illustrations which are included in the manuscript.

#### DESCRIPTION OF SPECIES

Hymenoptera belonging to the two tribes, *Stizini* and *Bembicini*, which seem to me to form a subfamily, Bembicinae,<sup>3</sup> may be distinguished from all other members of the order by the following

<sup>3</sup> This agrees with the arrangement proposed by Rohwer, Bull. 22, Conn. Geol. Nat. Hist. Surv. (1916), 1917, p. 691, except that it excludes the genus *Sphécus* and reduces the group from family to subfamily rank.



combination of characters: Lateral expansion of the pronotum forming on each side a well differentiated, rounded lobe (tubercle) which does not touch the tegula; posterior metatarsus not dilated; no plumose hairs present; maxillae normal, or if elongate, then the ocelli are more or less reduced or distorted; hind wing always with an anal lobe that is short and lacks an auxiliary vein; abdomen sessile, with the male having seven and the female six exposed segments and the last sternite of the female not turned dorsally around the sting; three closed cubital cells, of which the second receives both recurrent veins; basal vein removed from the stigma by two or more times the distance from the apex of the radial cell to the apex of the wing; stigma small, not wider than the costal cell; neither epinemia nor episternal suture present; labrum exerted and often rostriform; mandibles without an external notch. Although the members of this subfamily are thus definitely distinguished from other hymenopterous forms by possessing in common the characters given above, nevertheless the two tribes may be distinguished from one another by characters that are equally definite. These are set forth below.

KEY TO THE TRIBES OF BEMBICINAE

1. Ocelli normal; dorso-ventral length of the labrum always less than its greatest width; tibia of second leg provided with two apical spurs; submediellan cell extending beyond the junction of the mediella and cubitella veins...**Stizini**.  
 Ocelli distorted or completely reduced to cicatrices; dorso-ventral length of the labrum equal to or greater than its greatest width; tibia of second leg provided with only one spur; submediellan cell not extending beyond the junction of the mediella and cubitella veins.....**Bembicini**.

Tribe STIZINI

Handlirsch in his *Monographie der mit Nysson und Bembex verwandten Grabwespen*, part 6, published in 1892, considered *Bembicinus* Costa and *Stizoides* Guerin as synonyms of *Stizus* Latreille, and Fox in his *Proposed Classification of the Fossorial Hymenoptera of North America* took the same position as Handlirsch. Kohl also considered these two genera synonyms of *Stizus* Latreille. After a careful study, however, of all available material, which included representatives of all these genera, I am convinced that the characters on which *Bembicinus* and *Stizoides* were based are of generic importance and I have accordingly given both names generic rank.

Of the two tribes, the Stizini appear to be the more primitive and therefore the less specialized group. In this tribe the ocelli are normal and the labrum has what may be regarded as the normal form; that is, its greatest width exceeds its dorso-ventral length. The tibia of the mesothoracic leg is provided with two spurs and the submediellan cell extends beyond the junction of the mediella and cubitella veins.

## KEY TO THE GENERA OF STIZINI

1. Posterior surface of propodeum concave, its posterior-lateral angles prominently compressed and wedge-shaped; second cubital cell petiolate; second abscissa of the cubitella lacking.....**Bembicinus.**  
 Posterior surface of propodeum flat or convex, its posterior-lateral angles rounded; second cubital cell not petiolate (rarely subpetiolate); second abscissa of both radiella and cubitella present.....**2.**
2. Inner eye-margins approximately parallel; mandibles dentate; second abscissa of the radiella at its origin strongly bent forward toward the costal border of the wing; scutellum of the female usually with a small median depression.....**Stizus.**  
 Inner eye-margins convergent at the clypeus; mandibles edentate; second abscissa of the radiella approximately straight; scutellum of the female without a median depression.....**Stizoides.**

Genus **BEMBICINUS** Costa

Figures 3, 4

*Bembicinus* COSTA, Fauna del Regno di Napoli, vol. 4, 1859.—PATTON, Bull. U. S. Geol. Surv., vol. 5, 1879, p. 345.—CRESSON, Synopsis, 1887, Supp. vol. Trans. Amer. Ent. Soc., p. 115.

*Stizus* HANDLIRSCH (part), Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 101, 1892, p. 26.—FOX (part), Proc. Acad. Nat. Sci. Phila., 1894, p. 304.—KOHLE (part), Ann. des. K. K. Naturhist. Hofmus., vol. 11, 1896, p. 421.—DALLA TORRE (part), Cat. Hym., vol. 8, 1897, p. 519.

*Genotype*.—*Vespa tridens* Fabricius, designated by Patton, 1879.

Members of this genus can readily be distinguished from those of the other two genera of the tribe by the character of the posterior surface of the propodeum. This is distinctly concave and its lateral angles are compressed and more or less prominently wedge-shaped. In this respect members of this genus resemble those of the genus *Bicyrtes* Lepeletier, but in this latter genus the ocelli are completely reduced to cicatrices.

Head broad as thorax; eyes strongly convergent at the clypeus; width of labrum approximately double its dorso-ventral length; posterior margin of tenth flagellar segment of the male prolonged into a slightly curved, slender process; posterior surface of the propodeum concave, its posterior-lateral angles compressed and more or less wedgelike; second cubital cell usually petiolate but in some cases the first and second cubital cross veins simply join at their union with the radial or even join the radial separately; mediellan cell subtends only one short vein, which is the second abscissa of the radiella; the first abscissa of the discoidella is much shorter than the width of the submediellan cell; eighth sternite of the male ends in three spines.

Genus *STIZUS* Latreille

Figures 1, 2

*Stizus* LATREILLE, Hist. Nat., vol. 3, 1802, p. 344.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 101, 1892, p. 26.—FOX, Proc. Acad. Nat. Sci. Phila., 1895, p. 266.—KOHLE, Ann. K. K. Naturhist. Hofmus., vol. 11, 1896, p. 421.—DALLA TORRE, Cat. Hymn., vol. 8, 1897, p. 519.

*Megastizus* PATTON, Bull. U. S. Geol. Surv., vol. 5, 1879, p. 344.—CRESSON, Synopsis, 1887, Supp. vol. Trans. Amer. Ent. Soc., pp. 115 and 278.

*Genotype*.—*Bembex ruficornis* Fabricius, designated by Latreille in 1810.

In this genus the inner eye-margins are approximately parallel, whereas in the other genera of the tribe the inner eye-margins are more or less strongly convergent at the clypeus. The posterior-lateral angles of the propodeum are rounded and the mandibles are dentate.

Head narrower than thorax; frons broad; inner eye-margins approximately parallel; width of labrum greater than its dorso-ventral length; mandibles dentate; flagellar segments of the male without processes; scutellum of the female with a more or less prominent medial depression (absent on some species); posterior surface of propodeum flat, its posterior-lateral angles rounded; first cubital cell twice the length of the radial cell; points of union of the first and second cubital cross veins with the radial vein always distinctly separated; mediellan cell subtending two short veins, the anterior of which (second abscissa of the radiella) is strongly curved forward at its origin; first abscissa of the discoidella is long, very much longer than the width of the submediellan cell; eighth sternite of the male ends in three spines.

*STIZUS OCCIDENTALIS*, new species

Figure 29

*Type* (male).—Black; labrum; clypeus; mandibles except tips; lower part of frons, except pair of black spots at junction of clypeus; pair of triangular spots below anterior ocellus; scape below; broad inner orbits; broad fascia on pronotum; tubercles; narrow line leading down from tubercles; conspicuous spot anterior to tubercles; tegulae; narrow lateral line on scutum above tegula; conspicuous interrupted fasciae on tergites, smallest on tergite one; fasciae on sternites 2-6 very much narrowed and interrupted medially; legs, except basal part of coxae; *yellow*. There is but little black upon the abdomen, this color being almost wholly replaced by ferruginous of varying degrees of intensity.

The first three or four segments of the flagellum and the terminal 1 are for the most part ferruginous. The segments of the flagellum gradually increase in diameter from the first to the eleventh; the twelfth is conical, scarcely curved, and roundly pointed. The radial cell is distinctly infumated, the remainder of the wing very slightly so, particularly in the mid-region.

*Allotype* (female).—The allotype resembles very closely the type in the general pattern of the maculations but the yellow and ferruginous are much more extensively developed. With the exception of a pair of spots above the base of the antennae the entire frons up to the level of the anterior ocellus is yellow. The prothorax is yellow and ferruginous; there is a yellow fascia on the scutellum and also one on the metanotum. On the scutum there is a pair of obscure ferruginous discal stripes and on the metapleura a small yellow spot and two ferruginous spots. The dorsum of the propodeum bears an obscure ferruginous curved fascia; the antennae are lighter than those of the type, the flagellum being ferruginous below throughout its length. As in the case of the type the radial cell is infumated but elsewhere the infumation of the front wing is less pronounced than in the case of the wing of the type.

The clypeus of this species is distinctly six-sided and is twice as wide as long dorso-ventrally. The frons is wider on the allotype than on the type and the inner eye-margins on both are approximately parallel. The head (except the eyes), the thorax, the propodeum, and the first segment of the abdomen are covered with thickly set, moderately long, white pubescence, which is better developed on the allotype than on the type. The scutellum of the allotype bears an evident medial pit studded with short white pubescence.

Length 20 mm. Described from two specimens, a male from San Diego County, Calif., collected by Mr. Coquillett, and a female from Florence, Ariz.

*Type* (male).—Cat. No. 40847, U.S.N.M. Allotype in the collection of the Academy of Natural Sciences of Philadelphia.

#### Genus STIZOIDES Guerin

Figures 5, 6

*Stizoides* GUERIN, Incon. du Regne Anim., 1844, p. 438.

*Stizus* PATTON, Bull. U. S. Geol. Surv., vol. 5, 1879, p. 346.—CRESSON, Synopsis, 1887, Supp. vol. Trans. Amer. Ent. Soc., pp. 115 and 278.—HANDLIRSCH (part), Sitz Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 101, 1892, p. 26.—FOX (part), Proc. Acad. Nat. Sci. Phila., 1895, p. 266.—KOHLE (part), Ann. des K. K. Naturhist. Hofmus., vol. 11, 1896, p. 421.—DALLA TORE (part), Cat. Hym., vol. 8, 1897, p. 519.

*Genotype*.—*Larra fasciata* Fabricius (*Stizus calopteryx* Handlirsch), by present designation.

In this genus the mandibles are edentate, a character not present in either of the other genera of the tribe. The inner eye-margins are convergent at the clypeus and the posterior-lateral angles of the propodeum are rounded.

Head broad as thorax; inner eye-margins distinctly convergent at the clypeus; labrum rather strongly arched, its dorso-ventral length about equal to its width; mandibles edentate; posterior surface of propodeum flat, posterior-lateral angles rounded; radial cell shorter than the first cubital cell, which is less than one and one-half times as long as the radial; second cubital cell not petiolate, but the first and second cubital cross veins may have a common point of union with the radial; second abscissa of both radiella and cubitella present and approximately parallel; first abscissa of discoidella longer than the width of the mediellan cell; tenth flagellar segment of male with conspicuous process; eighth sternite of male ending in three spines.

### Tribe BEMBICINI

With the exception of the genus *Bembix*, which is world wide in distribution, members of this tribe are confined to the Western Hemisphere. The ocelli are either completely reduced to cicatrices or are to a greater or less degree distorted. In some species the ocelli are still provided with more or less well-formed lenses, but whether these lenses are functional is a matter of conjecture. The labrum is well developed; its dorso-ventral length always exceeds its greatest width, and in some species its length is several times its width at the base. The tibia of the mesothoracic leg is provided with only a single spur. The submediellan cell does not extend beyond the junction of the mediella and cubitella veins.

#### KEY TO THE GENERA OF BEMBICINI

1. Maxillae unusually long, reaching the posterior coxae when at rest and incapable of being concealed behind the labrum; maxillary palpus composed of three segments; labial composed of one.....*Steniolia*.  
Maxillae when at rest concealed behind the labrum, or if elongated never reaching the posterior coxae; maxillary and labial palpi otherwise (in all genera except *Microbembex*).....2.
2. Anterior ocellus (or cicatrice) placed in a pit, the borders of which are distinctly elevated.....*Stictiella*.  
Anterior ocellus (or cicatrice) not placed in a pit.....3.
3. Posterior surface of propodeum (median segment) concave, its posterior-lateral angles prolonged, compressed, and wedgelike (in one species the posterior-lateral angles are rounded).....*Bicyrtes*.  
Posterior surface of propodeum (median segment) flat or convex; posterior-lateral angles rounded.....4.
4. Mandibles edentate.....5.  
Mandibles dentate (in some species teeth on inner margin of mandible may be vestigial).....6.

5. Anterior border of radial cell confluent with anterior border of wing; maxillary palpus composed of six segments, labial of four.....**Hemidula.**  
Anterior border of radial cell at distal end not confluent with anterior border of wing; maxillary palpus and labial palpus otherwise.....**Microbembex.**
6. Eyes hairy .....**Trichostictia.**  
Eyes naked .....7.
7. Maxillary palpus composed of six segments, labial composed of four.....8.  
Maxillary palpus and labial palpus otherwise.....10.
8. Anterior ocellus reduced to a cicatrice, circular in form but less than a complete circle in extent.....**Stictia.**  
Anterior ocellus reduced to a cicatrice, linear in form, transverse in position, arcuate in shape .....**Rubrica.**  
Anterior ocellus not completely reduced to a cicatrice; a true lens present, though more or less distorted.....9.
9. Nervulus postfurcal by a distance equal to or greater than its own length; origin of discoidella distad of the junction of the nervella and cubitella. **Editha.**  
Nervulus postfurcal by a distance less than its own length; origin of discoidella at the junction of the nervella and cubitella.....**Selman.**
10. Anterior ocellus not completely reduced to a cicatrice; maxillary palpus composed of five segments, labial composed of three.....**Therapon.**  
Anterior ocellus completely reduced to a transverse, linear cicatrice; maxillary and labial palpi not composed of five and three segments, respectively. **Bembix.**

### Therapon, new genus

Figures 19, 20

*Monedula* HANDLIRSCH and AUTHORS (part).

*Genotype*.—*Stictia chilensis* Eschscholz.

The species on which the genus *Therapon* is based differs from all other species formerly included in the genus *Monedula* in that the maxillary palpus is composed of five segments and the labial of three. No other species in the entire subfamily have the palpi thus developed. In many respects *Therapon chilensis* resembles species of the genus *Trichostictia*: it has the maculations of the abdomen of the same color and the same general pattern; the pubescence of the thorax is similar; the ocelli are provided with lenses; and the spines on the middle coxae and the spatha of the genitalia of the male are also quite similar. It differs from the species of that genus, however, not only in the character of the maxillary and labial palpi, but also in the fact that the eyes of *chilensis* are not hairy and the clypeus is not produced upward between the antennae.

Head somewhat narrower than the thorax; eyes naked; vertex lower than the level of the top of the eyes; inner eye-margins slightly divergent at the clypeus; anterior ocellus with lens present, elliptical in form, transversely placed, and situated on a slight elevation; clypeus moderately arched, median apical area very little flattened,

carinate on median line at base but not markedly depressed on either side the midline at base; mandibles dentate; proboscis long, not wholly concealed when folded behind the labrum; maxillary palpus composed of five segments, labial of three; propodeum narrower than the thorax, its posterior-lateral angles narrowed and reduced; middle coxa of male provided with a relatively long, curved tooth; middle femur of male below at apical end provided with stout, flat tooth; second and sixth sternites of male plain; eighth sternite of male ends in short, stout, curved spine; seventh tergite of male unusually broad, bearing short, stout, lateral spines, the medial portion deeply and roundly emarginate; spatha of male genitalia as in Figure 77; venation of wings similar to that found in the genus *Stictia*.

**THERAPON CHILENSIS (Eschscholz)**

Figures 19, 20, 76-79

*Stictia chilensis* ESCHSCHOLZ, Naturw. Abh. Dorpat., vol. 1, 1823 (Entomograph. 1822), p. 150.

*Monedula d'Orbignii* BURMEISTER, Bol. Acad. Nac. Cordova, vol. 1, 1874, p. 116.

*Monedula chilensis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 132.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 497.

I have examined five males and three females of this species, of which Handlirsch in his monograph has given an excellent detailed description. The middle tibia of the male has the anterior apical border drawn out into a short spinelike process such as sometimes is found on species of *Bembix*. Three specimens from Chile, one female and two males, of which one is unusually small, have the dorsum of the thorax and propodeum, except for very small spots above the base of the wings, wholly black and the maculations on the sides of the thorax and propodeum greatly reduced or lacking. The remaining specimens, two males and two females from Argentina and one male from Chile, all have conspicuous lateral spots on the scutellum and well developed maculations on the sides of the thorax and propodeum. The pubescence on the thorax and propodeum is long, dense, and white but on the abdomen it is almost lacking. The seventh tergite of the male in this species is relatively broader than in any other species known at present. The lateral spines of this tergite are short and stout and the apex of the median part is strongly and roundly emarginate.

SPECIMENS EXAMINED

ARGENTINA: Bahia Blanca.

CHILE: Santiago (1923, Father C. Joseph); (E. C. Reed).

The species has been reported also from Peru, Patagonia, and La Plata.

## TRICHOSTICTIA, new genus

Figures 11, 12

*Monedula* HANDLIRSCH and AUTHORS (part).*Genotype*.—*Monedula vulpina* Handlirsch.

Wasps belonging to this genus have the eyes hairy. Of all the wasps formerly included in the genus *Monedula* none save those assigned to this genus possess this character. In addition to this they are also distinguished by the shape of the dorsal border of the clypeus, which on the medial line is produced upward to a point above the level of the lower border of the insertion of the antennae (fig. 11).

Head scarcely as wide as the thorax; vertex at midline slightly below the level of the top of the eyes; eyes hairy, their inner margins straight but divergent at the clypeus; anterior ocellus with lens present, in form somewhat elliptical, transversely placed, and situated on a distinct, rounded elevation; mandibles dentate; clypeus moderately arched, carinate on midline dorsally, median ventral area slightly flattened, and dorsal margin at midline produced upward between the antennae to a point above the level of the lower margin of their insertion; maxillary palpus composed of six segments, labial of four; propodeum narrower than the thorax, its posterior lateral angles less prominent than in allied genera; middle coxa of male with prominent, posterior, curved tooth; second and sixth sternites of male plain; eighth sternite of male ends in a single, curved spine; seventh tergite of male bears lateral spines and the apex of the median part is rounded, not emarginate; spatha of male genitalia as in Figure 70.

## KEY TO SPECIES OF TRICHOSTICTIA

1. Males (visible segments in abdomen 7; antenna composed of 13 segments) — 2.  
   Females (visible segments in abdomen 6; antenna composed of 12 segments) ----- 4.
2. Scape above wholly ferruginous; discal spots on tergites 4-6 usually (not always) united on midline ----- *guttata*.  
   Scape black above; discal spots on tergites 4-6 always separated on midline ----- 3.
3. Black on flagellum present to a greater or less degree on all segments; pubescence on thorax and propodeum white ----- *vulpina*.  
   Black on flagellum limited to apical half; pubescence on thorax and propodeum decidedly brownish ----- *brunneri*.
4. Scape above wholly ferruginous; scutellum bearing a complete fascia ----- *guttata*.  
   Scape black above; scutellum bearing only lateral spots ----- 5.
5. Black on flagellum present in greater or less degree on all segments; pubescence on dorsum of propodeum white ----- *vulpina*.  
   Black on flagellum limited to apical half; pubescence on dorsum of propodeum long and decidedly brown ----- *brunneri*.



**TRICHOSTICTIA GUTTATA (Taschenberg)**

Figure 70

*Monedula guttata* TASCHENBERG, Zeitschr. f. d. ges. Naturw., vol. 36, 1870, p. 23.*Monedula (Hemidula) guttata* BURMEISTER, Bol. Acad. Nac. Cordova, vol. 1, 1874, p. 120.*Monedula guttata* HANDLIRSCH, Sitz. Akad. wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 136.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 498.

I have examined four specimens of this species, two males and two females, all from Argentina, South America. Two of these, a male and a female, determined by Kohl, agree quite closely with Handlirsch's description of the species. Of the other two specimens that I have referred to this species, the male has the fascia on the scutellum interrupted at the midline and also has the discal spots on tergites 4 and 5 separated from one another as well as from the lateral spots on these same tergites. On the female the discal spots on tergite 4 are separated as on the male. On both male and female the maculations on the sternites consist of rather widely separated lateral spots and the sixth sternite of the female is wholly black.

## SPECIMENS EXAMINED

ARGENTINA: Mendoza (H. Rolle, Berlin W. Det. Kohl).

Handlirsch reports this species also from Montevideo, Uruguay.

**TRICHOSTICTIA VULPINA (Handlirsch)**

Figures 11, 12, 69

*Monedula vulpina* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 138.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 501.

Of this species I examined two males and two females, all from Chile. The species resembles the preceding but is not quite so slender and the maculations on the thorax are less extensive. The maculations on the sternites are almost pure white and the pubescence on the propodeum is long, dense, and white, characters that serve to distinguish this species from the other two belonging to the genus.

## SPECIMENS EXAMINED

CHILE: Santiago (December, 1922, A. Faz); Southern part (M. J. Rivera).

Handlirsch reports this species also from Peru.

**TRICHOSTICTIA BRUNNERI, new species**

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except small pair of discal spots and narrow border on baso-lateral margins; spot between antennae; scape and first two segments of flagellum below; narrow vertical stripe below anterior ocellus; broad anterior orbits deflected inward above anterior ocellus;

posterior orbits, broad below, narrow above; posterior border of pronotum extended around posterior border of tubercle; spot on side of prothorax; short lateral line above base of wings on scutum; narrow transverse, rectangular, lateral spots on scutellum; narrow interrupted fascia on posterior border of metanotum; small spot on side of propodeum: spot on metapleura; spot on mesopleura; lateral and discal spots completely separated on tergite one; discal spots separated from one another but united to lateral spots on tergites 2-5; four distinct spots on tergite 6; apical part of tergite 7; fasciae on sternites 2-5 broad laterally and almost interrupted by a deep anterior, median emargination; fascia on sternite 6 broad in the middle but narrowed laterally; femora in part; tibiae and tarsi wholly; *yellow*. The color of the maculations on the abdomen, labrum, clypeus, and scape is a very pale creamy yellow, while that on the thorax and legs is a much richer shade of yellow.

The basal half of the flagellum is ferruginous and none of the segments shows any special modifications. The apical part of the middle femur is dentate below. The median part of the seventh tergite is narrow and rounded at the apex while the lateral spines are short, rounded, and sharply pointed.

*Allotype* (female).—The allotype, with respect to the maculations, so closely resembles the type that a separate description is unnecessary. It differs from the type, however, in not having black discal spots on the clypeus; in having the black baso-lateral borders much reduced; in having the sides of the thorax and propodeum somewhat more extensively maculated; in having a pair of yellow spots on the posterior surface of the propodeum; in having the discal and lateral spots separated from one another on all the tergites except the fourth; and in having the coxae maculated. The sixth sternite has its apical portion wholly yellow.

The wings of this species are almost hyaline. The pubescence on thorax and propodeum is unusually dense, relatively long, and of a decidedly brownish color. There is some variation among the paratypes. On none of them do we find a pair of black spots on the clypeus. On one male the lateral and discal spots are separate on tergites 1-3, and on two of the females the lateral and discal spots are separate on all the tergites. The baso-lateral black border on the clypeus varies in extent but is never lacking. The extent of the maculations on the side of the thorax and propodeum varies on the different individuals.

This species is very closely related to *vulpina* (Handlirsch), from which it can be readily distinguished (1) by the maculations of the abdomen, which are practically white in *vulpina* and are creamy yellow in *brunneri*; (2) by the pubescence on the propodeum, which is decidedly white in *vulpina* and decidedly brownish in *brunneri*;

and (3) by the color of the basal half of the flagellum, which in both sexes of *vulpina* is predominantly black while in *brunneri* it is wholly or predominantly ferruginous.

Length 18–20 mm. Described from three males and five females. The males, including the type, and one of the females bear the simple label "Peru." Four of the females, including the allotype, bear the label "Arequipa, Peru, October 30, '98."

*Type*.—Male, Cat. No. 40848, U.S.N.M.

### EDITHA, new genus

Figures 25, 26

*Monedula* HANDLIRSCH and AUTHORS (part).

*Genotype*.—*Monedula magnifica* Perty.

This genus is very closely allied to the genus *Stictia*, from which it differs, however, in having the ocelli provided with well-formed lenses, in having the middle of the vertex not depressed but on a level with the top of the eye, in having the inner margins of the eyes strongly divergent at the clypeus, in having the temples broad, and in having the nervulus vein distinctly postfurcal.

Head narrower than thorax; eyes naked; ocelli provided with lenses; anterior ocellus circular in form but scarcely more than a semicircle in extent; inner eye margins strongly divergent at clypeus; vertex not depressed, middle part on a level with the top of the eyes; frons below anterior ocellus and dorsal part of clypeus distinctly carinate on median line; clypeus on either side the median carina somewhat depressed, ventral area more or less flattened; maxillary palpus composed of six segments, labial of four; nervulus joins the discoideus distinctly distad of the origin of the basal vein; middle coxa of male with short tooth; prominent groove and stout tooth on posterior, apical border of middle femur of male; seventh tergite of male with short, stout, lateral spines, and with median part short, broad, and truncate; eighth sternite of male ends in a single stout, curved spine; second and sixth sternites of male may or may not show distinct modifications or processes.

#### KEY TO SPECIES OF EDITHA

1. Males (abdomen with 7 visible segments; antenna with 13).....2.  
Females (abdomen with 6 visible segments; antenna with 12).....4.
2. Sixth sternite provided with a transverse row of spines.....3.  
Sixth sternite devoid of spines.....*magnifica*.
3. Maculations on tergites consisting of fasciae on first and second tergites.  
*adonis*.

Maculations on tergites consisting of lateral spots on tergites 1–4...*fuscipennis*.

- |   |                      |
|---|----------------------|
| 4. Maculations on tergites only lateral spots-----  | <i>fuscipennis</i> . |
| Maculations on tergites consisting of fasciae-----  | 5.                   |
| 5. Fasciae limited to first and second tergites-----  | 6.                   |
| Fasciae present on tergites 2-5-----  | <i>pulcherrima</i> . |
| 6. Large, length 35 mm. or more; ventral and dorsal areas of clypeus separated<br>by a well-defined transverse ridge----- | <i>magnifica</i> .   |
| Smaller, length 25 mm.; ventral and dorsal areas of clypeus ill defined;<br>transverse ridge almost lacking-----          | <i>adonis</i> .      |

**EDITHA MAGNIFICA (Perty)**

Figures 25, 26, 75

*Monedula magnifica* PERTY, Delectus Animal, Art. 144, pl. 28, fig. 3, 1834.—  
HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890,  
p. 122.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 498.

This handsome wasp, measuring from 35 to 45 mm. in length, is the largest species known among the bembicids. Its color is intense velvety black, with yellow markings on the head, broad yellow fasciae on first and second tergites, and yellow lateral spots on the second sternite. The temples in this species are very broad and yellow in color.

SPECIMENS EXAMINED

BRAZIL: Chapada (March).

**EDITHA ADONIS (Handlirsch)**

*Monedula adonis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol.  
99, 1890, p. 130; vol. 104, 1895, p. 969.—DALLA TORRE, Cat. Hym., vol. 8, 1897,  
p. 496.

*Monedula stridulans* STRAND, Zool. Jahrb. Abt. Syst. Geol. and Biol., p. 147.

A careful study of Strand's description of *M. stridulans* and a comparison of this description with Handlirsch's description of *M. adonis* convinces me that the two descriptions deal with one and the same species. In color this species so closely resembles *magnifica* that it appears to be only a smaller form of that species. The male of this species, however, differs from the male of *magnifica* in having the sixth sternite provided with a row of spines closely applied to the ventral surface of the sternite. The female is distinguished from the female of *magnifica* by its smaller size and by the lack of a transverse ridge separating the dorsal and ventral areas of the clypeus.

SPECIMENS EXAMINED

BRAZIL: Chapada (March).

PARAGUAY: ASUNCION, Villa Morra (January 7, 1906, J. D. Anisits, Det. Strand).

Handlirsch reports this species also from Ipanema, Brazil.

## EDITHA FUSCIPENNIS (Lepeletier)

*Monedula fuscipennis* LEPELETIER, Hist. Nat. Ins. Hym., vol. 3, 1845, p. 286.—  
HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p.  
128.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 497.

I have before me two males that were received by the United States National Museum in an exchange and were determined by Kohl as males of this species.

Handlirsch, in his discussion of this species, writes that he had only females before him and that Lepeletier and Dahlbom likewise examined only females. A comparison of these two males with Handlirsch's description of the species convinces me that Kohl's determination is correct. In this species the temples and the division of the clypeus into dorsal and ventral areas are by no means so prominent as in the case of *magnifica*. The middle femur at the apical end below bears the characteristic groove and tooth. The second sternite is plain and the sixth bears a transverse row of spine similar to those on the male of *adonis*. Segments 6–12 of the flagella below are somewhat excavated or modified; 6 bears an evident spine below; 8 and 9 each bears a smaller spine; and 9, 10, and 11 each at the apical end below bears on the anterior border a number of spine-like hairs. The spine on the eighth sternite of the male is distinctly spear-shaped. The wings are heavily and uniformly infumated. Of the two specimens one is without a locality label and the other bears the label "Brasilia, Esperito Santo."

Handlirsch reports the species from Ipanema and San Paola, Brazil.

## EDITHA PULCHERRIMA, new species

*Type* (female).—Black: labrum; clypeus, except fine line at base; base of mandibles; lower part of frons; broad anterior orbits; scape below; posterior orbits, narrowed above; large lateral spot on prothorax; broad fascia on pronotum, including the tubercles; pair of discal lines on scutum; spot on tegula; scutellum; metanotum; broad fascia on dorsum of propodeum narrowly interrupted on median line; lateral angles of propodeum broadly; small spot on metapleura; broad vertical line and small spot on mesopleura; first tergite, except a pair of longitudinal elliptical discal marks and a median anterior notch between them; broad fasciae on tergites 2–5 bisinuate on anterior margin, those on 2 and 3 each narrowed at the midline by a V-shaped notch; pair of triangular spots on sixth tergite; lateral spots on sternites 2–4; spot on anterior coxa; femora in part; tibiae, except posterior surfaces; anterior border of anterior tarsus; anterior border of middle tarsus to a less degree; apical segment of posterior tarsus in part; *yellow*.

Length about 27 mm.

The flagellum is black, with the tip of the apical segment reddish, the segments increasing in diameter outward to the tenth, thence slightly decreasing to the apex. The wings are hyaline. The pubescence is short and inconspicuous. The apical tergite bears a median carina and is closely and finely punctate, the punctures becoming coarser toward the apex, where a slight tendency to rugosity becomes evident. The sixth sternite is finely punctulate with widely separated coarser punctures scattered over the surface.

Described from a single female from Santa Isabel, Rio Negro, Uruguay, collected by J. D. Haseman.

*Type*.—Female, in the Carnegie Museum, Pittsburgh, Pa.

#### SELMAN, new genus

Figures 17, 18

*Genotype*.—*Selman angustus*, new species.

The characters that distinguish this genus from the genus *Stictia*, to which it is closely related, are the following: ocelli functional (at least not reduced to cicatrices); middle of vertex elevated instead of being depressed; body slender instead of stout and robust.

Head wide as thorax; eyes naked; ocelli provided with true lenses (not reduced to cicatrices); anterior ocellus circular in shape, but only slightly greater than a semicircle in extent; middle of vertex on a level with the top of the eyes; inner eye-margins parallel; slight but evident carina on lower part of frons and base of clypeus; middle part of the clypeus to near the base slightly flattened; maxillary palpus composed of six segments, labial of four; wings narrow and relatively short, about double the width of the thorax; venation of wings similar to that in the genus *Stictia*; body slender; male generic characters, if any, unknown.

#### SELMAN ANGUSTUS, new species

Figures 17, 18

*Type* (female).—Black: clypeus, except pair of transverse basal spots; labrum; mandibles, except tips; lower part of frons; scape; basal segments of flagellum below; broad anterior orbits shortened above; narrow posterior orbits broad below; tubercles continuous with broad spot on sides of prothorax and with broad fascia on posterior border of pronotum; lateral lines and pair of large, longitudinal, pear-shaped spots on scutum; fascia on anterior border of scutellum; narrow fascia on metanotum; arcuate fascia on propodeum extended in a pair of points on its posterior surface; posterior lateral angles and sides of propodeum; metapleura and mesopleura almost wholly; fasciae on tergites 1-5 interrupted at dorsal midline

and broader laterally than at midline; fascia on tergite 1 very broad laterally; continuous fascia on sixth tergite broad at midline and narrow laterally; continuous fasciae on sternites 2-5, broad laterally and narrow medially; legs, except line above on all femora and tibiae and spot below on all trochanters and proximal ends of all femora; *yellow*.

The flagellum, except the first and second segments, is more or less reddish below; above it is darker suffused with reddish basally. The distal end of the apical segment is distinctly reddish. The flagellum of the paratype shows but little of this reddish color except on the apical segment. The wings are hyaline, narrow, and relatively short. The pubescence is sparse and short, in fact, almost lacking. The discal marks on the scutum and the lower part of the maculation of the mesopleura show a tendency to the reddish color seen on the flagellum. The male of the species is unknown.

Length, 18 mm. Described from two specimens (including the type) from Chapada, Brazil.

*Type and paratype*.—In the Carnegie Museum in Pittsburgh, Pa.

#### Genus STICTIA Illiger

Figures 23, 24

*Vespa* LINNAEUS, *Systema Naturae*, ed. 10, vol. 1, 1758, p. 574 (part).

*Bembex* FABRICIUS, *Syst. Ent.*, 1775, p. 361.

*Bembex* FABRICIUS, *Mant. Ins.*, vol. 1, 1787, p. 285.—DAHLBOM, *Hym. Eur.*, vol. 1, 1845, p. 486.

*Monedula* LATREILLE, *Hist. Nat. Ins.*, vol. 3, 1802, p. 343.—DAHLBOM, *Hym. Eur.*, vol. 1, 1845, p. 492.—BURMEISTER, *Bol. Acad. Cordova*, vol. 1, 1873, p. 110.—HANDLIRSCH, *Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl.*, vol. 99, 1890, p. 77.—KÖHL, *Ann. des K. K. Naturhist. Hofmus.*, vol. 11, 1896, p. 439.—DALLA TORRE, *Cat. Hym.*, vol. 8, 1897, p. 496.

*Stictia* ILLIGER, *Fauna Etrusca* (Rossi), ed. 2, vol. 2, 1807, p. 131.—FOX, *Ent. News*, 1901, p. 269.—PARKER, *Proc. U. S. Nat. Mus.*, vol. 52, 1917, p. 15.

*Genotype*.—*Stictia signata* Linnaeus, designated by Parker in 1917.

Wasps belonging to this genus have the ocelli completely obliterated. The anterior cicatrice is circular in form but less than a complete circle in extent and is not placed in a pit or upon a distinct prominence or elevation. The middle of the vertex is depressed, is distinctly lower than the level of the top of the eyes, whose inner margins are somewhat divergent at the clypeus. The male has at the apical end of the posterior border of the middle femur a distinct notch and stout tooth. The sixth sternite of the male bears a conspicuous median area and the seventh tergite bears lateral spines and its median part is emarginate at the apex.

Head almost as wide as thorax; eyes large, their inner margins slightly divergent at clypeus and the facets near the inner border somewhat larger than those near the outer border; ocelli reduced completely to cicatrices, flat, not placed in a pit or on an elevation, circular in form but only slightly greater than a semicircle in extent; mandibles dentate; maxillary palpus composed of six segments, labial of four; clypeus but moderately arched and not distinctly divided into a dorsal and ventral area by a transverse ridge, a short carina at dorsal midline continuous with median carina of frons; median part of vertex depressed, distinctly below the level of the top of the eyes; lateral angles of propodeum somewhat prominent but rounded, not wedge shaped; seventh tergite of male with prominent lateral spines, the median part emarginate at apex; sixth sternite of male with median area slightly raised and granular in appearance; eighth sternite of male terminating in a stout curved spine; spatha of male genitalia as in Figure 72; venation of wings as in Figure 24.

## KEY TO SPECIES OF STICTIA

1. Males (abdomen with 7 visible segments, antenna composed of 13 segments) ----- 2.  
 Females (abdomen composed of 6 visible segments, antenna composed of 12 segments) ----- 16.
2. Maculations on tergites confined to lateral spots ----- 3.  
 Maculation on tergites in the form of fasciae, either more or less widely interrupted or broken into lateral and discal spots, or some broken into spots and others simply interrupted ----- 6.
3. Scutellum, metanotum, and dorsum of propodeum with broad, conspicuous fasciae; remainder of thorax and propodeum entirely black ---- trifasciata.  
 Thorax and propodeum not as above ----- 4.
4. Lateral spine on seventh tergite truncate and its apical surface concave. heros.  
 Lateral spine on seventh tergite not as above ----- 5.
5. Metanotum with narrow fascia continuous or interrupted; anterior metatarsus bearing eight spines ----- medea.  
 Metanotum black; anterior metatarsus bearing seven spines ----- antiopa.
6. Maculation of first tergite consisting of two fasciae united laterally and interrupted medially, thus forming a pair of U-shaped marks; no fasciae broken into lateral and discal spots ----- signata.  
 Maculation of first tergite otherwise: or if as above, then on one or more tergites the fascia is broken into lateral and discal spots ----- 7.
7. Fasciae on tergites not broken into lateral and discal spots. (Rarely fascia on third tergite may be broken, in which case the fasciae on the sternites are continuous) ----- 8.  
 Fasciae on some tergites or on all broken into lateral and discal spots --- 9.
8. Scutum without discal lines; fasciae on sternites 2-5 continuous -- decorata.  
 Scutum with prominent pair of discal lines; sternites 2-5 with only lateral spots ----- dives.
9. Fasciae on first and second tergites prominent; fascia on third broken into four spots; tergites 4 and 5 black or with small lateral spots; thorax and propodeum black ----- carolina.  
 Combination of maculations as given above not present ----- 10.





23. Fasciae on tergites simply interrupted (rarely broken on third tergite into lateral and discal spots)-----29.  
 Some or all of the fasciae on tergites broken into lateral and discal spots...30.
29. Sixth tergite with evident median carina extending the length of the tergite; posterior tibiae black with silvery pubescence; labrum yellow.  
*vivida.*  
 Median carina on sixth tergite reduced or wanting; posterior tibiae marked with yellow; labrum with median black stripe-----*dives.*
30. Posterior tarsi almost wholly yellow; mesopleura wholly yellow-----31.  
 Posterior tarsi almost wholly black; mesopleura not wholly yellow, only maculated-----*pantherina.*
31. Scutellum lacking pubescence, very finely punctured with a few scattered larger punctures; labrum yellow; discal stripes on scutum narrow--*andrei.*  
 Scutellum pubescent (at least at sides), uniformly and rather coarsely punctate; labrum with black central stripe; discal stripes on scutum broad-----*maculata.*

**STICTIA TRIFASCIATA, new species**

Figure 72

*Type* (male).—Black: longitudinal lateral stripes on labrum; apical line on clypeus joined to a median vertical line to base of same; pair of minute spots between antennae; narrow line on scape below; narrow anterior orbits; very narrow posterior orbits; broad fascia with short sharp prolongation at its posterior middle on scutellum; fascia on metanotum; broad curved fascia on propodeum; conspicuous, widely separated lateral spots on tergites 1–5, decreasing in size from one to five; minute lateral spots on sternite three; narrow stripe on anterior border of tibia and tarsus of first pair of legs; small spot at distal end of femora of middle and posterior legs; *yellow*. The flagellum is black and segments 6, 10, 11, and 12 bear prominent pits below, the excavation on 6 being best developed. Segments 7 to 9 bear shallow pits and are somewhat rounded out below.

This species, which in Handlirsch's key runs to *Monedula heros*, is remarkable for the presence of the three yellow bands on the thorax and propodeum. These are unusually well developed; yet, aside from these, the thorax and propodeum are entirely black. The spots on the tergites are well developed but are widely separated and the ventral surface is wholly black except for the small pair of spots on the third sternite. The wings are slightly infumated, due to the fact that the veins are bordered by a slightly infumated area, particularly evident on the anterior pair.

Length 26 mm. Described from a single male from Sapucy, Paraguay, South America.

*Type* (male).—Cat. No. 40849, U.S.N.M.

## STICTIA HEROS (Fabricius)

*Bembex heros* FABRICIUS, Syst. Piez., 1804, p. 222.

*Monedula heros* HANDLIRSCH, Sitz. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 108.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 498.

*Stictia heros* and the two species immediately following, *medea* and *antiopa*, are distinguished by having only widely separated lateral spots on the tergites and relatively few or no maculations on the thorax and propodeum. The maculations on the tergites of *heros* are a pale creamy color, almost white, whereas those on *medea* and *antiopa* are decidedly yellowish and the wings of *heros* are less heavily infumated than are those of the other two species. I have at hand 2 males and 11 females of this species, of which one female bearing the label, "Panama" has been determined by Handlirsch.

## SPECIMENS EXAMINED

ECUADOR: Posorja.

PANAMA: Ancon, Canal Zone (L. H. Dunn): Old Panama (May 15, 1909, A. H. Jennings; Jan. 31, 1911, A. Busck).

Handlirsch reports this species from Montevideo, and also from Rio Grande do Sul and Santa Catherina, Brazil.

## STICTIA MEDEA (Handlirsch)

*Monedula medea* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 109.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 498.

I have before me from Brazil four females that I have referred to this species. All bear fasciae on the metanotum; on three the curved fascia on the propodeum is continuous, on the fourth interrupted; on one the fascia on the scutellum is continuous, on a second it is narrowly interrupted, and on the other two it is reduced to lateral spots. On all four the maculations are a bright light yellow.

I have before me also a male from Surinam determined by Kohl as belonging to this species. Handlirsch did not have a male at hand when he described the species, and if Kohl has published a description of the male, I have not seen it. The maculations on the tergites of this specimen are more yellowish than in the case of the males of *heros*, but the difference is not so great as in the case of the females of the two species. The sixth segment of the flagellum and also the three apical segments are deeply excavated, much more so than is true of *heros*. Furthermore, the apical surface of the lateral spine on the seventh tergite of *heros* is distinctly excavated, whereas in the case of *medea* the lateral spine is bluntly rounded at the apex.

## SPECIMENS EXAMINED

BRAZIL: Amazonas, Rio Branco (Nov., 1903, P. Kibler S. Rolle V.): Souza, Para (Sept. 16, 1920, Cornell U. Exped.).

SURINAM.

## STICTIA ANTIOPA (Handlirsch)

*Moredula antiopa* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 109.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 496.

Handlirsch described this species from a single female and distinguished the species from *heros* because of the finer puncturing of the scutum and heavier infumation of the wings of this species, and from *medea* through the lack of yellow fasciae on the scutellum, metanotum, and propodeum. I have at hand a female, determined by Kohl, that bears the characters given by Handlirsch. I have also another female (labeled "Surinam"), which I have referred to this species and which bears a pair of lateral spots on the scutellum, a small pair on the metanotum, and small spots on the posterior lateral angles of the propodeum. The wings are more heavily infumated than those of *medea*.

Of a male that I have determined as belonging to this species, I submit the following description: Black: lateral borders of labrum; ventro-lateral borders and median vertical stripe on clypeus; scape below: vestiges of anterior and posterior orbits; very small lateral spots on scutellum; very small lateral spots on dorsum of propodeum; small spots on lateral angles of propodeum; lateral spots on tergites 1-5; lateral spots on sternites 2-4; anterior lines on anterior femora and tibiae; posterior apical spot on middle and posterior femora; *yellow*.

The wings are more heavily infumated than in the case of *heros* or *medea*. The lateral spines of the seventh tergite are more nearly perfectly truncate than are those of *medea* and are not hollowed out at the apex as are those of *heros*.

## SPECIMENS EXAMINED

SURINAM: (Fruhstorfer).

VENEZUELA: Maturin (1898—female, det. Kohl).

## STICTIA SIGNATA (Linnaeus)

## Figure 23

*Vespa signata* LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 574.

*Moredula signata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 86.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 499.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 104, 1895, p. 966.

*Stictia signata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 18.

This species is one of the most common and most widely distributed of the genus, having been reported from localities scattered throughout South America, Central America, Mexico, and the West Indies. I have examined more than one hundred specimens of this species, which may be distinguished from all other species of the genus by

the fact that the first tergite bears a pair of U-shaped maculations whose open ends are approximated and by the fact that the fasciae on the remaining tergites, though interrupted at mid line, are never broken into discal or lateral spots.

## SPECIMENS EXAMINED

- BAHAMAS: Andreas Island (J. J. Northrop).  
 BOLIVIA: Herachi Beni (September, W. M. Mann); Rurrenabaque, Beni (October, W. M. Mann).  
 BRAZIL: Ceara-Mirim (W. M. Mann); Flores (November 15, 1919, Parish); Itacoatira (November 22, 1919, Parish); Manaos (Mann, Baker); Matto Grosso; Obidos (August 10, 1919, Parish); Para (Mrs. H. B. Merrill).  
 BRITISH GUIANA (April 9, 1901, R. J. Crew).  
 COSTA RICA: San Carlos (Schild and Burgdorf).  
 CUBA: Baracoa (August, 1901, A. Busck); Cabanas (May 18, Palmer and Riley).  
 ECUADOR (C. T. Baker).  
 FLORIDA.  
 GUATEMALA: Los Amates (February 7, 1905).  
 HONDURAS: La Ceiba (April 8, 1916, F. J. Dyer).  
 MEXICO: Cozacocalcos (December, 1898, C. C. Deam); Rosario, Sinaloa (B. P. Clark); Santa Lucretia, Vera Cruz (F. Knab).  
 PANAMA: Alhajuelo (April 10, 1911, A. Busck); Taboga Island (February 16, 1912, A. Busck); Tabernilla (A. Busck); Old Panama (January 31, 1911, A. Busck).  
 PARAGUAY: Sapucay (April 8, 1903, W. T. Foster).  
 PERU: Lima (December 21, 1912, C. H. T. Townsend).  
 SAN SALVADOR: Cockburntown (P. Bartsch).  
 SURINAM.  
 VENEZUELA: Rio Moto, Cuara District (October 9, M. A. Carriker).

*STICTIA DECORATA* (Burmeister)

*Monedula punctata* var. *decorata* TASCHENBERG, Zeitschr. f. d. ger. Nat., 1870, p. 22.

*Monedula decorata* BURMEISTER, Bol. Acad. Cordoba, vol. 1, 1874, p. 144.—HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 105.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 497.—HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 104, 1895, p. 968.

I have at hand a single male of this handsome species determined by Kohl. The clypeus and labrum are wholly yellow; the yellow on the scutum is confined to short, narrow lateral lines above the base of the wings; the fasciae on tergites 1-5 are well developed and are narrowly interrupted at midline; tergite 6 bears small lateral spots; sternites 2-5 bear broad fasciae narrowed at midline; sternite 6 bears small lateral spots. Segment 6 of the flagellum is only moderately excavated below and at the apex bears below a single short but distinct spine. The lateral spines of the seventh tergite can not be said to be truncate, but at the end they are sloping and terminate in a blunt, rounded point.

## SPECIMENS EXAMINED

ARGENTINA: Mendoza (December 14, 1906, H. Rolle Berlin W.).

Handlirsch reports this species also from Philippi, Chile.

## STICTIA DIVES (Handlirsch)

*Monedula dives* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 106.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 497.

I have before me a single male specimen that I have referred to this species. Unfortunately it bears no locality label. It has a pair of small medial black spots on the clypeus and a short median black stripe at the apex of the labrum. In other respects the coloration of this specimen fits very accurately the description of the male of the species given by Handlirsch. The excavation on the sixth segment of the flagellum is a little more prominent than in the case of *decorata*, and, as in the case of that species, this segment bears a distinct spine on the distal margin below. The lateral spines on the seventh tergite are distinctly and almost squarely truncate.

Handlirsch described the species from specimens from Mexico.

## STICTIA CAROLINA (Fabricius)

## Figure 24

*Bembex carolina* FABRICIUS, Ent. Syst., vol. 2, 1793, p. 249.

*Stictia carolina* ILLIGER, Mag. f. Ins., vol. 6, 1807, p. 195.

*Monedula carolina* LEPELETIER, Hist. Nat. Hym., vol. 3, 1845, p. 281.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 110.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 497.

With the exception of a single specimen of *Stictia signata* taken in California (D. W. Coquillett), this large and handsome species is the only one of the genus to occur within the bounds of the United States, and, so far as I am aware, it has not been found without them, although it is highly probable that it will be found in Mexico. Its large size, black thorax sparsely maculated or not at all, and the broad, bright, creamy maculations of the abdomen render this species easy of identification.

## SPECIMENS EXAMINED

ALABAMA: Booth (June 15, 1924, E. S. Holt); Montgomery (T. J. Key).

FLORIDA: Apalachicola (July, 1909, J. C. Bradley); Fernandina (W. H. Finn); Jacksonville (Ashmead); Palm (C. F. Baker).

GEORGIA: Egypt (W. H. Finn).

LOUISIANA: Houma (August 6, 1911, E. C. Wurzlów); Lee Post Office (June 29, 1896, D. W. Eavens).

MARYLAND: Chesapeake Beach (July 26, 1912, William Palmer).

OKLAHOMA: Ardmore (June 26, C. R. Jones).

TEXAS: Calmesneil (June 20, 1907, W. W. Yothers); Dallas (June 6, 1910, E. G. Blasi); Jacksonville (June 28, 1906, F. C. Bishopp); Kerrville (July 19, 1907, F. C. Pratt); Rosser (July 6, 1905, F. C. Bishopp); Victoria (May 30, 1911, J. D. Mitchell).

In addition to the localities listed above, the species has been reported from Illinois, Kansas, New Jersey, New Mexico, and Pennsylvania.

STICTIA MEXICANA (Handlirsch)

Figure 74

*Monedula mexicana* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 107.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 498.

Of the five males that I have referred to this species, four have conspicuous discal lines, and lateral lines above the base of the wings, on the scutum, but the fifth lacks the discal lines and the lateral lines are much reduced. On this same fifth specimen the fascia both on the scutellum and on the metanotum is interrupted and the fascia on the propodeum is almost obsolete while the maculations on the mesopleura and metapleura are wholly wanting and those on the lateral angles of the propodeum are reduced to small spots. On all five the fascia on the third tergite is broken into lateral and discal spots and on three of the five the fascia on the first tergite is likewise broken into lateral and discal spots.

Handlirsch described the species from two males from Mexico. A female bearing the label, "Cuernavaca, 9, '23, Moi Mex., E. G. Smyth," I regard as the female of this species. Its description is as follows: Black—lateral borders of labrum; mandibles in part; very narrow lateral spots on ventral border of clypeus; short anterior orbits; very narrow posterior orbits; posterior border of pronotum, almost obsolete; posterior border of tubercle; lateral spots on scutum above base of wings; narrow and widely interrupted fascia on scutellum; narrow, interrupted fascia on metanotum; fasciae on tergites 1-3 broken into lateral and discal spots; fasciae on tergites 4 and 5 widely interrupted; lateral spots on sternites 2-4; narrow line on anterior border of anterior tibia and tarsus and on anterior border of middle tibia; *yellow*.

The scutellum is closely and evenly punctured throughout but nowhere are the punctures of uniform size; the size and the number of coarse punctures are greater, however, in the central area than on any of the four margins. The eleventh segment of the antenna at the middle on its posterior border bears a short rounded tooth, a character that I should consider an abnormality did it not occur on both antennae. The infumation of the wings is somewhat heavier

than in the case of the male, particularly along the margins of the veins.

MEXICO: Atencingo (June 1 and 2, 1922, E. G. Smyth); Cuernavaca (September, 1923, E. G. Smyth).

**STICTIA PANTHERINA (Handlirsch)**

*Monedula punctata* var. LEPELETIER, Hist. Nat. Ins. Hym., vol. 3, 1845, p. 285.

*Monedula pantherina* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 95.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 498.

I have at hand five females that I have referred to this species, which is closely related to *maculata* and like *maculata* has the discal spots on tergites 1-4 always separate from the lateral spots. The following characters serve to distinguish this species from *maculata*: the discal lines on the scutum of this species are usually very much narrower than those on *maculata*; the maculations on the sides of the thorax and propodeum of *pantherina* are much reduced, whereas on *maculata* these parts are wholly or almost wholly yellow; the tarsi, particularly the hind tarsi on *pantherina* are almost wholly black, whereas the tarsi, particularly the hind tarsi on *maculata* are predominantly or wholly yellow.

**SPECIMENS EXAMINED**

FRENCH GUIANA: Cayenne (February, March, 1917).

VENEZUELA: Pedernales (January 25, 1911, S. Browne).

Handlirsch reports this species from Colombia and Brazil.

**STICTIA SOMERANA, new species**

*Type* (male).—Black: clypeus, except pair of broad stripes extending from base almost to apex; labrum: spot between antennae; scape below; anterior orbits shortened above; posterior orbits narrowed above; prothorax, except band extending from one tubercle to the other; pair of narrow discal lines and short line above base of wings on scutum; narrow interrupted fascia on anterior margin of scutellum; narrow fascia on metanotum; lateral lines on propodeum; posterior-lateral angles and large spot on sides of propodeum; metapleura; mesopleura; mesosternum except pair of round spots; pair of small discal and large lateral spots on tergites 1-4; large lateral spots on tergite 5; apex of seventh tergite: lateral spots on sternites 2-5, those on second sternite being very large; legs except black lines on femora and tibiae; *yellow*. The color of the labrum, clypeus and the maculations on the tergites is very light creamy yellow; that of the legs and thorax, orange yellow.



This species seems close to *Stictia mexicana* Handlirsch and, like that species, has the hind metatarsus unusually long, in this species nearly as long as the hind tibia. The apical segment on the anterior and middle tarsi (posterior missing) is marked with a black spot. The sixth segment of the flagellum is excavated on its posterior surface and is slightly spinose as is also the seventh and ninth. The tenth, eleventh, and twelfth segments are also excavated below. The lateral spines of the seventh tergite are almost squarely truncate. The wings are hyaline. The punctation of the scutellum is relatively fine and uniform; that of the scutum is similar to that of the scutellum save that very fine punctures are scattered among the coarser ones.

Length about 25 mm. Described from a single male (the type) taken by J. Chester Bradley and bearing the label, "La Sombra to El Encapto, Putumayo Dist., Peru, Aug. 23, '20."

*Type*.—In the collection of Cornell University.

#### STICTIA MACULATA (Fabricius)

*Bembex maculata* FABRICIUS, Syst. Piez., 1804, p. 222.

*Monedula maculata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 92.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 498.

This species is characterized by having broad longitudinal discal stripes on the scutum; fasciae on scutellum, metanotum and propodeum; the sides of the thorax and propodeum wholly yellow or nearly so, and on some specimens the greater part of the venter of the mesothorax also yellow; the discal spots on tergites 1-4 separated from the lateral spots; and the tarsi preponderantly or entirely yellow. On some specimens the maculations on the first tergite resemble those found on *Stictia signata* but in all cases observed the U-shaped marks were more or less broken. On some specimens one or both of the discal spots on the second tergite may be united with the corresponding lateral spot, but on no specimen studied did I find such a union on the fourth tergite—here the discal spots are always distinct. The sixth tergite of the female is invariable black and the form of the lateral spines of the seventh tergite of the male is similar to that of *signata*.

#### SPECIMENS EXAMINED

BRITISH GULANA: Essequibo (William Schaus).

COSTA RICA: Carillo, San Carlos (Schild and Burgdorf).

MEXICO: (C. F. Baker).

PANAMA: Alhajuelo (A. Busck); Cobima (May 24, 1911, A. Busck); Punta de Pensa (July 22, 1908, R. E. B. McKenney).

PERU: El Campaniento (June 28, 1920, Perene).

## STICTIA PUNCTATA (Fabricius)

*Bembyx punctata* FABRICIUS, Ent. Syst., 1775, p. 361.

*Monedula punctata* HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 97.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 499.—HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 104, 1895, p. 967.

This species once seen can scarcely be mistaken for any other of the known species of *Stictia*. The thorax and propodeum are black, sometimes wholly black, but usually with very small lateral spots on the scutellum, on the sides of the mesothorax, and on the posterior lateral angle of the propodeum. Sometimes there are traces of yellow on the prothorax. The paired discal spots on tergites 1—4 are small, widely separated from one another and widely separated from the small lateral spots on the same segments. The legs are black, with traces of yellow or ferruginous, especially on the front pair. I have at hand one male and eight females of this species.

## SPECIMENS EXAMINED

BRAZIL: Guaraja, Sao Paulo (December 2, 1916, Cornell U. Exped.); Pernambuco (December 28, 1882); Sao Paulo (Hammar).

## STICTIA LINEATA (Fabricius)

*Bembex lineata* FABRICIUS, Ent. Syst., vol. 2, 1793, p. 250.

*Bembex punctata* OLIVER, Enc. Meth., vol. 4, 1798, p. 290. (Misidentification).

*Monedula punctata* BURMEISTER, Bol. Acad. Cordoba, vol. 1, 1874, p. 111.

*Monedula lineata* HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 100.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 498.

This species most closely resembles *Stictia punctata*, from which it may be distinguished by the presence of fasciae on the scutellum and the metanotum and usually also on the propodeum. I have at hand one male and four females that I have referred to this species. The male has the fasciae on the scutellum and metanotum very narrow, and the fascia on the propodeum is reduced to a pair of small lateral spots. The posterior lateral angles of the propodeum bear yellow spots. There are small lateral spots on the scutum above the base of the wings, a small spot on the mesopleura below the wings, and a fascia on the pronotum that does not reach the tubercles, which are wholly black. The maculations on the abdomen are characteristic of the species. The apex of the lateral spine of the seventh tergite is obliquely truncate and its posterior angle is bluntly pointed. The male is large and robust, as is also one of the females. Two of the females are much smaller than the others and they have the scape wholly black. One of these two has the clypeus black and the yellow on the labrum reduced to small lateral spots; the other one has the

yellow on the clypeus reduced to mere traces at the extreme ventro-lateral borders and the yellow on the labrum reduced to lateral lines. The yellow on the prothorax is reduced to spots on the tubercles. The fasciae on scutellum, metanotum, and propodeum are well developed, as are the maculations on the abdomen. There are also small spots on the sides of the thorax and propodeum. The legs are predominantly black, but on three of the four females the apical segment of the tarsi is largely or wholly yellow, whereas on the fourth female and on the male this yellow is reduced to a spot or is wanting.

## SPECIMENS EXAMINED

## ARGENTINA.

BRAZIL: Chapada (March 10); Sao Paulo (Hammar); Guaraja, S. Paulo (December 2, 1919, Cornell U. Exped.).

Fabricius reports the species from Cayenne.

## STICTIA INFRACTA, new species

*Type* (female).—Black: labrum; mandibles, except tips; clypeus, except a small pair of black spots; lower part of frons extended on median line above antennae; scape below; anterior orbits; posterior orbits broad below; narrow posterior border of pronotum; tubercles and sides of prothorax almost entirely; narrow lateral lines on scutum; narrow fascia of scutellum; fascia on metanotum; narrow fascia on propodeum extending downward in a V-shaped prolongation on the posterior surface and inclosing a triangular black spot; posterior-lateral angles and sides of propodeum almost wholly; metapleura and mesopleura, except black lines at the sutures; mesosternum, except a pair of black spots in front of middle coxae; broad continuous fasciae on tergites 1-5, slightly emarginate at anterior middle and produced forward slightly on either side the emargination on all except the first, and produced forward laterally on all; pair of median spots on anterior surface of tergite 1; interrupted fascia on tergite 6 produced forward laterally as on preceding; sternites 1-3 entirely; 4, except anterior median spot; 5, except median and pair of lateral black spots; pair of small lateral spots at apex of sixth; legs entirely, except black lines above on all femora and tibiae; *yellow*. Flagellum black above, tawny below. Wings hyaline.

In form this species is relatively slender and resembles more closely members of the genus *Bembix* than it does the robust forms of *Stictia*. If it were not for the form of the anterior ocellus and the character of the mouth parts, it would readily pass for a *Bembix*. The color of the dorsal markings and the clypeus is a pale greenish or creamy yellow, while that of the labrum, the ventral markings, and

the legs is more nearly orange. The pubescence is white, very short, and sparse. The swelling at the base of the second sternite is less evident than is usual in this genus. The sixth tergite is coarsely punctate with a slight tendency to become rugose at the apex. It bears a slight but evident median carina and along the lateral borders are numerous coarse, stiff hairs. The sixth sternite is also slightly carinate on the median line and is covered with uniform shallow punctures, among which, toward the apex, are numerous coarser ones.

Length, 19 mm. Described from a single female taken at Piura, Peru, by Townsend, April 28, 1911.

*Type* (female).—Cat. No. 40850, U.S.N.M.

**STICTIA CARBONARIA (Burmeister)**

*Monedula carbonaria* BURMEISTER, Bol. Acad. Nac. Cordova, vol. 1, 1874, p. 113.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 102.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 497.

I have at hand two females of this species determined by Handlirsch. On one specimen the sides of the thorax are entirely black, except for a very narrow line on the border of the prothorax below the tubercles. On the other specimen these same lines below the tubercles are present and also a minute spot below the wings on the mesothorax. On this latter specimen there is a trace of color on the posterior border of the pronotum, but on both specimens the tubercles are black as is likewise the scutum.

SPECIMENS EXAMINED

BRAZIL: Ihering, Rio Grande (Det. Handlirsch).

Handlirsch reports this species from Parana and Montevideo, and cites Burmeister as reporting it from Corrientes and Rio Quaiquiraro.

**STICTIA ARCUATA (Burmeister)**

*Monedula punctata* var. *arcuata* TASCHENBERG, Zeitschr. f. d. g. Nat., vol. 2, 1870, p. 22.

*Monedula arcuata* BURMEISTER, Bol. Acad. Cordova, vol. 1, 1874, p. 112.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 104.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 496.

I have before me two females of this species determined by Handlirsch. The prothorax, exclusive of the broad fascia on the pronotum including the tubercles, is entirely black. The scutum, the mesopleura, the metapleura, and the side of the propodeum, exclusive of the posterior lateral angles, are also black. The scutellum on its anterior border bears a broad fascia narrowly interrupted at the midline. The metanotum is almost wholly yellow and there is a broad curved fascia on the propodeum and its posterior lateral angles

are yellow. The fascia on the third tergite is broken into lateral and discal spots.

## SPECIMENS EXAMINED

BRAZIL: Ihering, Rio Grande (Det. Handlirsch).

Handlirsch reports this species also from Montevideo and cites Burmeister as reporting it from Uruguay and from Mercedes, Argentina.

## STICTIA VIVIDA (Handlirsch)

*Monedula vivida* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 101.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 501.

I have at hand seven females from Mexico that I have referred to this species. The labrum is wholly yellow and the clypeus also, except for a large basal mark that is almost divided into two by a wide median yellow stripe. The scutum bears a pair of lateral yellow lines and a pair of long, narrow, rufous discal lines. There is a conspicuous fascia on the anterior border of the scutellum narrowed medially and partially or wholly interrupted at the median line. The metanotum is almost wholly yellow and the broad, curved fascia on the propodeum covers much of the posterior surface. There is a fascia on the posterior border of the pronotum that includes the tubercles. There are large maculations on the sides of the mesothorax and metathorax and the sides of the propodeum are almost entirely yellow. The fasciae on the tergites are unusually well developed, resembling both in size and color those of *decorata*. They are interrupted at midline, the posterior ones somewhat more widely than the anterior ones, but in no case is any fascia broken into discal and lateral spots. Three of the seven specimens have the sixth tergite with a pair of small yellow spots. This tergite is closely punctured, the punctures near the apex being coarser than those toward the base, and practically all the punctures subtend stiff spinelike hairs which are very conspicuous along the lateral borders of the tergite. This tergite bears a distinct median carina as does also the sixth sternite. The legs, which are covered with a fine silvery pubescence, are black with some reduced yellow markings. The wings are hyaline. It is a large, brightly-colored, handsome species.

## SPECIMENS EXAMINED

MEXICO: Alta Mira, Tampa (June 30, 1903).

## STICTIA PROSERPINA (Handlirsch)

*Monedula proserpina* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 99.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 499.

I have at hand a single specimen, a female from Bolivia. It agrees quite closely with Handlirsch's description of the species. The macu-

lations on the clypeus are reduced to a short median stripe and a pair of small lateral spots. The widely interrupted fasciae on the tergites are broad laterally but are very narrow medially. The third is broken into lateral and discal marks.

## SPECIMENS EXAMINED

BOLIVIA: Rio Colorado (September, M. R. Lopez).

Handlirsch described the species from specimens taken at or near Nauta, Peru.

## STICTIA ANDREI (Handlirsch)

*Monedula andrei* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 94.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 496.

I have at hand two females of this species determined by Handlirsch, of which one bears the label "E. Peru" and the other "Nauta." The characteristics of this species, as set forth by Handlirsch, are well shown by these two specimens. All the specimens, 3 males and 21 females, on which Handlirsch based his description of the species, were from Peru.

## Genus STICTIELLA Parker

Figures 13, 14, 32

*Stictiella* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 21.

*Genotype*.—*Monedula formosa* Cresson, designated by Parker in 1917.

This genus may be distinguished from all nearly related genera, except *Steniolia*, by the fact that the ocelli are placed in pits or depressions. From *Steniolia* it may readily be distinguished by the character of the maxillae, which in *Steniolia* are exceedingly long, reaching the hind coxae, and can not be folded behind the labrum when at rest, whereas in *Stictiella* the maxillae are of normal development. Available records indicate that this genus is confined to North America.

Head usually as wide as the thorax, in some species narrower; eyes naked, their inner margins approximately parallel or slightly divergent at the vertex; ocelli placed in pits or depressions, their lenses not completely obliterated, but much distorted; anterior ocellus with a distinct elevation round about it; middle of vertex not depressed below level of top of eyes; clypeus only slightly arched, no dorsal median carina present and no flattened ventral area; mandibles dentate; maxillary palpus composed of six segments, labial of four; posterior apical border of middle femur of male lacking groove and stout tooth, such as is present in the genus *Stictia*; seventh tergite of

male without lateral spines; eighth sternite of male terminating in three spines and in some species provided with an additional discal spine; venation of wings as in Figure 14; spatha of male genitalia as in Figure 32.

## KEY TO THE SPECIES OF STICTIELLA

1. Males (antenna with 13 segments; abdomen with 7 visible segments).....2.  
    Females (antenna with 12 segments; abdomen with 6 visible segments).....20.
2. Middle metatarsus more or less strongly curved; inner curved surface frequently beset with spines.....3.  
    Middle metatarsus not curved.....13.
3. Second sternite nontuberculate.....4.  
    Second sternite unituberculate.....8.  
    Second sternite bituberculate.....9.
4. Middle femora smoot beneath.....pictifrons.  
    Middle femora serrate or dentate beneath.....5.
5. Pulvilli large and distinct; apical segment of all tarsi black; anterior tarsi dilated and flattened.....formosa.  
    Pulvilli indistinct; tarsi normal.....6.
6. Scutum with discal marks; abdominal fasciae all continuous...melanosterna.  
    Scutum without discal marks; no continuous fasciae on sternites.....7.
7. Wings hyaline; lateral spots on sternites lacking or confined to sternites 2 and 3.....plana.  
    Wings distinctly infumated; lateral spots on sternites not confined to sternites 2 and 3.....serrata.
8. Apical segment of anterior tarsus broadly dilated and black; process on second sternite blunt and strongly hirsute distally.....tuberculata.  
    Apical segment of anterior tarsus normal form and yellow; process on second sternite pointed and smooth distally.....callista.
9. Middle femora smooth below; head narrower than thorax.....10.  
    Middle femora serrate or dentate below; head normal.....11.
10. Width of second cubital cell on radial and cubital veins about equal; second sternite almost wholly yellow.....bituberculata.  
    Width of the second cubital cell on the radial vein about half its width on the cubital; second sternite mostly black.....emarginata.
11. Pulvilli indistinct; apical segment of tarsi normal.....pulchella.  
    Pulvilli distinct; apical segment of tarsi black; anterior pair dilated....12.
12. Large and stout, 18-20 mm.; fasciae on tergites broad and, except first, continuous; second inclosing pair of black discal spots; fasciae on sternites continuous or narrowly interrupted.....speciosa.  
    Slender, about 15 mm., fasciae on tergites interrupted on 1 or 1-3, leaving on one or more of these tergites a pair of yellow discal spots; yellow on sternites in form of lateral spots.....spinifera.
13. Head, thorax, base of abdomen and basal joints of legs covered with long, dense, white pubescence; most specimens, but not all, have the second sternite bituberculate.....scitula.  
    Pubescence of head, thorax, etc., of normal character.....14.
14. Second sternite nontuberculate.....tenuicornis.  
    Second sternite unituberculate.....15.  
    Second sternite bituberculate.....16.
15. Tubercle of second sternite ending in a single point.....megacera.  
    Tubercle of second sternite ending in two points.....bifurcata.

|  |                      |
|--|----------------------|
| 16. Middle femora of normal form, not emarginate-----  | 17.                  |
| Middle femora more or less strongly emarginate posteriorly-----  | 19.                  |
| 17. Scutum with a pair of discal marks-----  | <i>exigua</i> .      |
| Scutum without discal marks-----   | 18.                  |
| 18. Clypeus with black more or less extensive on dorsal border-----  | <i>pulla</i> .       |
| Clypeus wholly pale and silvery-----   | <i>argentata</i> .   |
| 19. Scape black above; mesosternum marked with black; genital stipes as in<br>Figure 33-----   | <i>femorata</i> .    |
| Scape entirely yellow; mesosternum yellow; genital stipes as in Fig-<br>ure 34-----  | <i>divergens</i> .   |
| 20. Pulvilli distinct-----   | 21.                  |
| Pulvilli indistinct-----   | 25.                  |
| 21. Scutum without discal markings-----  | 22.                  |
| Scutum with discal marks more or less well developed-----  | 23.                  |
| 22. Head narrower than thorax; width of second cubital cell on radial vein<br>about half its width on cubital-----   | <i>emarginata</i> .  |
| Head normal, wide as thorax; second cubital cell normal-----   | 23.                  |
| 23. Anterior and middle femora entirely yellow-----  | <i>argentata</i> .   |
| Anterior or middle femora or both marked with black-----   | 24.                  |
| 24. Spots on scutellum rectangular; spots on either side of anterior ocellus.<br>Spots on scutellum triangular; V-shaped spot enclosing anterior ocellus.<br>-----                   | <i>pulla</i> .       |
| -----  | <i>megacera</i> .    |
| 25. Discal marks on scutum, consisting of a pair of irregular spots, or of pair<br>of lines not broken, not curved inward or approximated posteriorly-----                           | 26.                  |
| Discal marks on scutum in form of a U, either broken, interrupted medially,<br>or broken into lines and spots-----   | 28.                  |
| 26. Scutellum with pair of large triangular lateral spots-----   | <i>pulla</i> .       |
| Scutellum with a continuous fascia, rarely interrupted on the median<br>line-----  | 27.                  |
| 27. Fasciae on tergites yellow; that on first tergite deeply emarginate on an-<br>terior border at midline or entirely cut through, leaving a posterior me-<br>dian discal spot----- | <i>pictifrons</i> .  |
| Fasciae on tergites pale; that on first tergite not deeply emarginate on<br>anterior border-----   | <i>argentata</i> .   |
| 28. Second sternite more or less black; not entirely yellow-----   | 29.                  |
| Second sternite entirely yellow-----   | 31.                  |
| 29. Species small, 10-12 mm.; discal marks on scutum narrow and broken;<br>fasciae on tergites rather narrow, wavy, scarcely to be considered emar-<br>ginate-----                   | <i>femorata</i> .    |
| Species larger, 16-20 mm.; discal marks on scutum two broad lines curved<br>and approximated posteriorly; fasciae on tergites broad and emarginated<br>anteriorly-----               | 30.                  |
| 30. Tergites without posterior black border; posterior tarsi, save basal joint,<br>dusky above-----  | <i>speciosa</i> .    |
| Tergites with a posterior black border; posterior tarsi yellow-----  | <i>formosa</i> .     |
| 31. Species large, 15-20 mm-----   | 32.                  |
| Species small, 10 mm-----  | 34.                  |
| 32. Clypeus with pair of basal black spots-----  | <i>bifurcata</i> .   |
| Clypeus entirely yellow-----   | 33.                  |
| 33. Scape yellow; black spot on mesosternum near middle coxa-----  | <i>tenuicornis</i> . |



- Scape with black spot above; mesosternum yellow-----bituberculata.
34. Fascia on first tergite inclosing a medial black spot basally; head, thorax, and base of abdomen covered sparsely with long, white pubescence, most evident on the lateral angle of the propodeum-----scitula.  
Fascia on first tergite without medial black spot; pubescence not as above; face and sides of thorax more or less silvery-----exigua.
35. Scutum without discal markings-----36.  
Scutum with discal markings-----37.
36. Mesopleura immaculate; fascia on first tergite interrupted widely---serrata.  
Mesopleura with large yellow spot; fasciae on all tergites continuous. pulchella.
37. Discal marks on scutum small; mesopleura black, rarely with small maculations; venter of abdomen almost entirely black-----38.  
Discal marks on scutum conspicuous; mesopleura yellow; venter of abdomen almost entirely yellow-----39.
38. Wings infumated; fascia on first tergite widely interrupted and yellow. serrata.  
Wings hyaline; fascia on first tergite narrowly interrupted and white. plana.
39. Species large, 18-20 mm.; no black on mesosternum-----callista.  
Species smaller, 12-14 mm.; black spot, variable in size, in front and slightly above middle coxa-----melanosterna.

## STICTIELLA PICTIFRONS (Smith)

*Monedula pictifrons* SMITH, Cat. Hym. Brit. Mus., vol. 4, 1856, p. 335.

*Monedula incermis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 144.

*Monedula denverensis* CAMERON, Trans. Amer. Ent. Soc., vol. 34, 1908, p. 235.

*Stictiella pictifrons* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 25.

The female of this species, in color and color pattern, so closely resembles *Steniolia duplicata* Provancher that it is very frequently mistaken for that species and I have frequently found specimens so labeled. The maculations on the dorsal side of the thorax and abdomen of the male are much lighter than on the female; in fact, they are almost white. The male is characterized by having on the third and fourth segments of the anterior tarsus well developed posterior apical processes that are invariably black.

## SPECIMENS EXAMINED

COLORADO: Livermore (July 8, 1900); Boulder (September 8, 1908, S. A. Rohwer); Denver (August 24, 1908, C. Bennett).

GEORGIA: Marietta (June 7, 1909).

NEW MEXICO: Las Vegas, Hot Springs.

PENNSYLVANIA: Carlisle Junction (July 1, 1909, P. R. Myers).

TEXAS: Kerrville (June 19, 1907, F. C. Pratt).

This species has also been reported from Virginia, North Carolina, Kansas, Arizona, and California.

## STICTIELLA FORMOSA (Cresson)

## Figure 32

*Monedula formosa* CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 221.

*Monedula speciosa* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 140.

*Stictiella formosa* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 27.

The males of this species can be readily distinguished by the character of the apical segment of the anterior tarsus. This is black, greatly dilated and flattened, its claws are greatly modified and, strange to say, the two claws are not alike. The claws on the middle and posterior tarsi are of normal form.

## SPECIMENS EXAMINED

OKLAHOMA: Bennington (August 28, 1907, F. C. Bishopp).

TEXAS: Paris (August 11, 1904, C. R. Jones); Sabinal (June 13, 1910, F. C. Pratt).

This species has also been reported from Kansas. It has also been reported from Guaymas, Sonora, Mexico, by C. L. Fox.

## STICTIELLA MELANOSTERNA Parker

*Stictiella melanosterna* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 30.

The type and allotype of this species (in United States National Museum) were taken at Las Cruces, N. Mex. It has been reported also from Arizona and Utah.

## STICTIELLA PLANA (Fox)

*Monedula plana* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 367.

*Monedula usitata* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 371.

*Stictiella plana* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 32.

This species is not represented in the collection of the United States National Museum. In his description of his species *usitata* Fox associated as sexes of one species male and female that in my judgment belong to different species. The evidence on which I based my conclusions was presented in my previous paper. The male of Fox's *usitata* I regard as the male of Handlirsch's *pulla* and the females of *usitata* I have associated with the male of Fox's *plana* as sexes of the same species.

## STICTIELLA SERRATA (Handlirsch)

*Monedula serrata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 99, 1890, p. 143.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 499.

*Stictiella serrata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 31.

## SPECIMENS EXAMINED

FLORIDA: Biscayne Bay.

GEORGIA: Tipton (May 18, 1896).

NORTH CAROLINA: Southern Pines (June 5, 1909, A. H. Manee): White Lake. Bladen County (March, 1909, F. Sherman).

This species has also been reported from Wisconsin.

**STICTIELLA TUBERCULATA (Fox)**

*Monedula tuberculata* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 366.

*Stictiella tuberculata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 34.

Fox's type, which is in the collection of the Academy of Natural Sciences of Philadelphia, is from Nevada. A specimen of this species, which I have examined, was taken by Mr. C. L. Fox at Lewiston, Idaho.

**STICTIELLA CALLISTA Parker**

*Stictiella callista* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 34.

The type and allotype of this species (both in the United States National Museum) were taken at Mesilla Park, N. Mex., by Cockerell, the former on June 9, 1898, and the latter on July 21.

**STICTIELLA BITUBERCULATA Parker**

*Monedula tenuicornis* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 369, male (not female).

*Stictiella bituberculata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 36.

The male of this species is characterized by its narrow head, its curved middle metatarsus destitute of spines on the curved surface, the bituberculate second sternite, and the paired discal spots, almost white, on the tergites. The female resembles the female of *tenuicornis*, from which it may be distinguished by the characters set forth in the accompanying key. Furthermore, the abdomen of the female of *tenuicornis* is more slender and the tendency of the fasciae on the tergites is to inclose black discal spots, whereas on *bituberculata* the tendency of the fasciae on the tergites is to break up into lateral and discal yellow spots.

**SPECIMENS EXAMINED**

CALIFORNIA: San Bernardino County (Coquillet); Los Gastos Canyon, Mount Diablo Range (June 2, 1907, J. C. Bradley).

This species has been reported from Arizona and New Mexico.

*Type*.—In the United States National Museum.

**STICTIELLA EMARGINATA (Cresson)**

*Monedula emarginata* CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 468.

*Monedula mamillata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 99, 1890, p. 146.

In this species the head is narrower than the thorax, more evident in the male than in the female, and the second cubital cell is greatly

narrowed on the radial vein. The second sternite of the male is bituberculate, the tubercles being widely separated. The specimen from Pennsylvania (male) and also the specimen from Giant Forest, Calif., have the maculations yellow instead of white, which is the color in the case of all other specimens of this species that I have seen.

## SPECIMENS EXAMINED

CALIFORNIA: Giant Forest (C. L. Fox).

COLORADO: Custer County (T. D. A. Cockerell); West Cliff.

OREGON: Mount Hood (C. L. Fox).

PENNSYLVANIA: Carlisle Junction (May 24, 1910, W. S. Fisher).

WYOMING: Snake River (August 18, 1917, W. B. Sheppard).

## STICTIELLA PULCHELLA (Cresson)

*Monedula pulchella* CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 471.

*Monedula minutula* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 99, 1890, p. 148.—DALLA TORRE, Cat. Hym., vol. 8, 1891, p. 498.

*Stictiella pulchella* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 40.

This species was described by Cresson from two females and one male taken in Colorado. All the material at hand was taken in California as indicated below.

## SPECIMENS EXAMINED

CALIFORNIA: Los Angeles County (Coquillett); Los Gastos Canyon, Mount Diablo Range, Fresno County (June 2, 1907, J. C. Bradley).

## STICTIELLA SPECIOSA (Cresson)

*Monedula speciosa* CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 470.

?*Monedula speciosa* PATTON, Bull. U. S. Geol. Surv., vol. 5, 1879, p. 361.

*Stictiella speciosa* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 41.

There are in the collection of the United States National Museum three female specimens of this handsome species. The maculations of the thorax and abdomen are almost white. The legs are yellow with the apical tarsal segments of the middle and posterior legs decidedly dusky or black. On one specimen this is true for the apical segment of the anterior tarsi.

## SPECIMENS EXAMINED

CANADA: Medicine Hat, Assiniboia (August 20, 1916, Sladen).

COLORADO: Sterling (August 8, 1904, Johnson).

NEBRASKA: West Point (J. C. Crawford).

This species has been reported also from Kansas and New Mexico. Cresson's type (a female) in the collection of the Entomological Society of Philadelphia is from Colorado.

## STICTIELLA SPINIFERA (Mickel)

- ?*Monedula speciosa* PATTON, Bull. U. S. Geol. Surv., vol. 5, 1879, p. 361.  
*Monedula speciosa* H. S. SMITH, Univ. Neb. Studies, vol. 8, 1908, p. 383 (part).  
*Monedula spinifera* MICKEL, Trans. Amer. Ent. Soc., vol. 42, 1916, p. 418.  
*Stictiella metampous* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 43.

This species stands very close to *speciosa*, from which it differs in the character of the second cubital cell and in the pattern of its maculations.

## SPECIMENS EXAMINED

KANSAS: Seward County (August, 1911, F. X. Williams).

Mickel reports the species from McCook and Glen, Nebr.

## STICTIELLA SCITULA (Fox)

## Figure 14

- Monedula mamillata* Fox (not Handlirsch), Proc. Calif. Acad. Sci., div. 2, vol. 4, 1893, p. 10.  
*Monedula scitula* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 369, female.  
*Monedula villosa* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 370, male.  
*Stictiella villosa* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 45.  
*Stictiella scitula* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 46.  
*Stictiella scitula* C. L. Fox, Proc. Calif. Acad. Sci., vol. 12, 1923, p. 433.

In a preceding paper I pointed out the possibility of Fox's *scitula* and *villosa* being sexes of the same species. They are found in the same locality; they have the venation of the wings the same; and both have the pubescence unusually well developed. This unusual development of the pubescence alone is strong evidence that they are sexes of one species. So far as I am aware no one has ever taken a male of *scitula* or a female of *villosa*. C. L. Fox reports that E. P. Van Duzee at Guaymas, Mexico, took three specimens of *villosa*, all males, and in the same locality 13 specimens of *scitula*, all females. I have accordingly reached the conclusion that they represent a single species, and since they were both described in the same paper, I have retained as the specific name the name of the species described first in the preparation of that paper. The female of *scitula* has the anterior metatarsus much flattened with the posterior border somewhat curved. It bears eight well-developed spines and on some specimens one or more additional spinelike hairs. Two headless females in the collection of the United States National Museum are marked "type" but by whom this was done I do not know.

## STICTIELLA TENUICORNIS (Fox)

- Monedula tenuicornis* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 368, female.  
*Stictiella tenuicornis* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 47.

In his description of this species Fox associated as sexes of one species males and a female that in my judgment belong to different

species. Since the female in his description is the type of this species, I redescribed the males under the specific name of *bituberculata*, the description appearing in my previous paper on the Bembicine wasps.

## SPECIMENS EXAMINED

ARIZONA.

CALIFORNIA: San Berdina County (Coquillett).

TEXAS: Laredo (May 16, 1924); Chisohn Mountains, Brewster County (Mitchell and Cushman).

## STICTIELLA MEGACERA Parker

*Stictiella megacera* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 49.

The male of this species may be recognized by the very large hirsute process on the second sternite; by the widening of the flagellum at the third segment; and by the character of the eighth sternite with its short terminal spine, shorter lateral spines, and at the base of the terminal spine the conspicuous hump, which is not developed into a discal spine. The female shows none of these characters, but, as in the male, the legs are relatively short and stout, the middle metatarsi being unusually thick and heavy. The second cubital cell on the female is almost a perfect rectangle.

## SPECIMENS EXAMINED

COLORADO: Arboles (C. F. Baker).

MEXICO: Tepoca Bay, Sonora (C. L. Fox).

UTAH: Iron County.

WASHINGTON: North Yakima (July 17, 1903, Eldred Jenne).

## STICTIELLA TERLINGUAE C. L. Fox

*Stictiella terlinguae* C. L. Fox, Pan-Pac. Ent., vol. 4, No. 3, 1928, p. 103.

This species was described by Mr. Fox from specimens taken at Terlingua, Tex., by J. O. Martin on May 6, 1927. The description was published after my key to the species in this genus had been prepared; consequently this species is not included therein. According to the description, the male of this species runs in my key to the male of *magacera*, from which species it may be distinguished by the prominent discal spine on the eighth sternite, a character lacking in *magacera*. The female runs to the female of *tenuicornis*, which species has the fasciae on the tergites of the female unbroken, whereas on this species the fasciae on the tergites are broken into lateral and discal spots.

*Type and allotype*.—In the collection of the California Academy of Sciences.

## STICTIELLA BIFURCATA C. L. Fox

*Stictiella bifurcata* C. L. Fox, Proc. Calif. Acad. Sci., vol. 12, 1923, p. 431.

This species, like *Stictiella pictifrons*, is remarkable for its superficial resemblance to *Steniolia duplicata* Provancher, the resemblance

being even greater in this species than in *pictifrons*. The male, however, is readily distinguished by the unique character of the process on the second sternite, which is well developed, its ventral surface being unusually broad and its posterior end terminating in two points. The female may be distinguished from *pictifrons*, with which species it is most likely to be confused, by the wholly yellow second sternite, the broken U-shaped discal mark on the scutum, and especially by the presence of more or less black on the base of the clypeus.

## SPECIMENS EXAMINED

MEXICO: Angelus Bay, Gulf of California (June 26, 1921, E. P. Van Duzee); Guaymas (April 7, 1921, E. P. Van Duzee).

Fox has described a variety of this species under the name of *albicerca*, which differs from the species chiefly in having the fascia on the tergites more broken into discal and lateral spots and in having these discal spots white instead of yellow. With respect to structural characters, I have been unable to find any essential difference between the variety and the species.

## STICTIELLA EXIGUA (Fox)

*Monedula exigua* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 370.

*Stictiella exigua* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 50.

This species is not represented in the collection in the United States National Museum. It has been reported from Arizona and Montana, and by C. L. Fox from various points on the Gulf of California.

## STICTIELLA PULLA (Handlirsch)

*Monedula pulla* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 149.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 499.

*Monedula usitata* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 371.

*Stictiella pulla* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 52.

Handlirsch based his description of this species on the female. A careful study of Fox's description of his *usitata* convinced me that the male he referred to *usitata* is the male of Handlirsch's *pulla*. The considerations that led to this conviction are set forth in my previous paper.

## SPECIMENS EXAMINED

CALIFORNIA: Los Angeles County (Coquillett); San Diego County (Coquillett); San Gabriel (C. E. Hutchinson).

WASHINGTON.

## STICTIELLA ARGENTATA C. L. Fox

*Stictiella argentata* C. L. Fox, Proc. Cal. Acad. Sci., vol. 12, 1923, p. 434.

This species is closely related to *Stictiella pulla* Handlirsch, from which the male of this species may be distinguished by the absence

of any black on the clypeus. The female also lacks any black on the clypeus and further differs from *pulla* in having a fascia on the scutellum and in having the fascia on the first tergite very broad and without a median anterior emargination. On this species the clypeus, frons, and thorax, in general, are more silvery than are these same parts on *pulla*. The femora on the female of *pulla* are more or less heavily marked with black; on *argentata* the femora of the female are entirely yellow.

## SPECIMENS EXAMINED

CALIFORNIA: San Diego County (Coquillett).

MEXICO: Angeles Bay (June 25-27, 1921, E. P. Van Duzee).

## STICTIELLA FEMORATA (Fox)

## Figure 33

*Monedula femorata* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 368.

*Stictiella femorata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 53.

The male of this species may be recognized by the emarginate middle femora, the bituberculate second sternite and rudiments of similar processes on sternites 3 and 4, and by the shape of the genital stipes. The female may be known by its small size, and its non-emarginate white tergal fasciae, which unite with the fasciae on the sternites to form continuous rings around the abdomen. The second cubital cell is much narrower on the radial vein than it is on the cubital.

## SPECIMENS EXAMINED

FLORIDA: Jacksonville (Ashmead).

TEXAS: Brownsville; Cotulla (April 15, 1906, F. C. Pratt); Sabinol (May 26, 1910, F. C. Pratt); Sweet Water (June 19, 1909, F. C. Bishopp).

## STICTIELLA DIVERGENS Parker

## Figure 34

*Stictiella divergens* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 55.

Only the male of this species is known. It is closely related to *S. femorata* Fox, from which it can be distinguished by its more extensive maculations, richer yellow color, and particularly by the form of the genital stipes. It is not represented in the collection of the United States National Museum. The type is in the collection of the University of Kansas, in which State the only specimens known were taken.



Genus *STENIOLIA* Say

Figures 7, 8, 31

*Steniolia* SAY, Bost. Journ. Nat. Hist., vol. 1, 1837, p. 367.—PATTON, Bull. U. S. Geol. Surv., vol. 5, 1880, p. 364.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 504.—KÖHL, Ann. des K. K. Naturhist. Hofmus., vol. 11, 1896, p. 435.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 501.—PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 5.

*Genotype*.—*Bembex longirostris* Say (monobasic).

The extraordinary length to which the maxillae are developed, extending when at rest to the hind coxae, distinguishes members of this genus from those of all related genera. The genus seems to be confined to the mountainous regions of western North America and to extend down through Central America to northern South America, from which but a single species has been thus far reported. This was taken in Ecuador.

Head wide as thorax; eyes naked, their inner margins approximately parallel; ocelli not completely obliterated, placed in pits or depressions; anterior ocellus somewhat elliptical vertically, the sides of the pit elevated above the general surface of the frons; vertex depressed slightly below the level of the top of the eyes; clypeus somewhat arched, carina on dorsal median line continuous with carina between antennae; mandibles dentate; maxillae extremely long, reaching when at rest, the hind coxae; maxillary palpus composed of three segments, labial of one; propodeum narrower than thorax, its posterior lateral angle rounded; middle femur of male without modifications; eighth sternite ending in three spines and bearing also a more or less well-developed discal spine; venation of wings as in Figure 8; spatha of male genitalia as in Figure 31.

KEY TO THE SPECIES OF *STENIOLIA*

- |  |                       |
|--|-----------------------|
| 1. Males (abdomen with 7 visible segments, antenna with 13 segments).....                        | 2.                    |
| Females (abdomen with 6 visible segments, antenna with 12 segments).....                         | 12.                   |
| 2. Middle tibia dilated.....   | 3.                    |
| Middle tibia not dilated.....  | 4.                    |
| 3. Abdominal maculations white.....  | <i>obliqua</i> .      |
| Abdominal maculations yellow.....  | <i>tibialis</i> .     |
| 4. Apical segment of tarsi black.....  | <i>nigripes</i> .     |
| Apical segment of tarsi not black.....   | 5.                    |
| 5. Abdomen almost wholly yellow.....   | <i>sulfurea</i> .     |
| Abdomen black and yellow, or black and white.....  | 6.                    |
| 6. Clypeus yellow.....   | 7.                    |
| Clypeus black or with pair of black spots (or black nasal area) more or less well developed..... | 10.                   |
| 7. Femora, particularly the third pair of femora, black and ferruginous.....                     | <i>longirostris</i> . |
| Femora not black and ferruginous.....  | 8.                    |

8. Maculations on tergites 1-5 broken into lateral and a pair of white discal spots ----- *elegans*.  
 Maculations on tergites 1-5 not as above ----- 9.
9. Flagellar segments 4-7 bearing small, narrow pits ----- *duplicata*.  
 Flagellar segments 4-7 not bearing pits ----- *dissimilis*.
10. Femora, particularly the third pair, black and ferruginous ----- 11.  
 Femora not black and ferruginous ----- *albicantia*.
11. Abdominal markings yellow; spine on second sternite well developed. *longirostris*.  
 Abdominal markings white; spine on second sternite lacking or weakly developed ----- *guatamalensis*.
12. Middle tibia dilated ----- 13.  
 Middle tibia not dilated ----- 14.
13. Abdominal maculations white ----- *obliqua*.  
 Abdominal maculations yellow ----- *tibialis*.
14. Femora, particularly the third pair, black and ferruginous ----- 15.  
 Femora not black and ferruginous ----- *duplicata*.<sup>4</sup>
15. Maculations on tergites rich yellow; apical border of tergites rufous. *longirostris*.  
 Maculations on tergites white or yellowish white; apical border of tergites black ----- *guatamalensis*.

#### STENIOLIA OBLIQUA Cresson

*Steniolia obliqua* CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 469.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 511.—DALLA TORRE, Cat. Hym., vol. 8, p. 501.—PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 12.

This species is characterized by its swollen or inflated middle tibia, more evident on the male than on the female, and by its white maculations and white pubescence.

#### SPECIMENS EXAMINED

COLORADO: Boulder (September 8, 1908, S. A. Rohwer); Florissant (June 29, July 1, S. A. Rohwer); Silver Plume (July 10, 1897).

UTAH: Ogden (L. Brunner).

WYOMING: Carbon County.

This species has been found also in Oregon.

#### STENIOLIA TIBIALIS Handlirsch

*Steniolia tibialis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 513.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 501.—PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 14.

This species like *obliqua* is characterized by a swollen or inflated middle tibia, but with this species the maculations are bright yellow instead of white. In the collection of the California Academy of Sciences there is an interesting form concerning which Mr. C. L.

<sup>4</sup> Here belongs also the female of *dissimilis*, on which I failed to find characters on which I could rely with certainty to separate it from *duplicata*.

FOX writes me as follows: "I carefully examined that interesting dark brown specimen taken by Doctor Van Dyke at Meadow Valley, Plumas County, Calif., and except for the color I can not separate it from *tibialis*. I think, as Doctor Van Duzee suggested, it is just a case of melanism. On the same date and at the same locality Doctor Van Dyke collected 20 males and 2 females, which I have determined as *tibialis*."

I have seen the specimen of which Mr. Fox here writes and I think he is right. It is a male and entirely without maculations, but aside from this fact it agrees in other respects with *tibialis*.

## SPECIMENS EXAMINED

CALIFORNIA: Meadow Valley, Plumas County (Doctor Van Dyke); Sierra Nevada.

Handlirsch reports this species from Nevada.

**STENIOLIA NIGRIPES** Parker

*Steniolia nigripes* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 8.

This species is not represented in the United States National Museum. It is known only from the type, a male in the collection of the Academy of Natural Sciences, of Philadelphia, taken at Los Angeles, Calif. Its distinguishing characters are the black apical segment of all tarsi and the peculiar form of the spines of the eighth sternite.

**STENIOLIA SULFUREA** Fox

*Steniolio sulfurca* FOX, Journ. N. Y. Ent. Soc., vol. 9, 1901, p. 84.—PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 9.

This species is not represented in the United States National Museum. So far as I am aware it is known only from two males (one the type) in the collection of the American Museum of Natural History, taken in California. It is distinguished by having the entire abdomen, except the basal part of the first segment, bright sulphur yellow.

**STENIOLIA LONGIROSTRIS** Say

## Figure 31

*Steniolia longirostris* SAY, Bost Journ. Nat. Hist., vol. 1, 1837, p. 366.—HANDLIRSCH, Sitz, Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 508.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 501.

In his description of this species Say points out the presence of black upon both clypeus and labrum. In his description and discussion of this species Handlirsch fails to note these characters, although he had before him 20 males of the species. Say's descrip-

tion is based upon the male. It appears that he did not have a female of the species. Of the females that I have referred to this species neither clypeus nor labrum shows any trace of black marks. Of the males, at one extreme of the series the clypeus is almost entirely black and there is a broad black band across the base of the labrum; at the other extreme both clypeus and labrum are entirely free from black marks of any kind. If I had had only the two extremes of this series before me, I should have hesitated to include them in a single species, but the series shows such a gradual transition from one extreme to the other as to make it impossible to separate the series into two groups, since the variations in the series with respect to other characters bear no relation to this variation in the maculation of the clypeus and labrum. All specimens that I have referred to this species, both male and female, agree in having the hind femora ferruginous and black and the apical borders of the tergites rufous. Since the specimens referred to this species by Handlirsch also bore these characters, I am convinced of the correctness of his determination. I have at hand 14 males and 5 females.

#### SPECIMENS EXAMINED

MEXICO: Cuautla (October 30, 1922, E. G. Smyth, also November 4, 1922); "Dist. Fedrl" (J. R. Inda); Guanajuato (A. Duges); Mitla (May 2, 1904, L. O. Howard).

#### STENIOLIA ELEGANS, new species

*Type* (male).—Black: clypeus; labrum; mandibles, except apices; scape below; space between antennae; broad anterior orbits narrowed to a point above; V-shaped spot below anterior ocellus; narrow posterior orbits broad below; posterior border of pronotum; tubercles; spot on sides of prothorax; pair of lateral spots and pair of small discal spots on scutum; triangular lateral spots on scutellum; fascia on posterior border of metanotum; pair of oblique lines on dorsum of propodeum prolonged on its posterior surface; sides of propodeum almost entirely; narrow stripe broken into three spots on anterior of mesopleura; fasciae on tergites 1–5 broken into a pair of rounded discal spots and a pair of sinuate lateral spots, of which those on one and two are very broad; fascia on tergite 6 interrupted and bisinuate on either side the midline; apex of seventh; fasciae on sternites 1–6, that on second very broad, and those on second and third very narrowly interrupted at midline; legs except trochanters. coxae basally, black line above and below on femora, and black line above on middle and anterior tibiae; *yellow or white*. The dorsal markings of the abdomen are white with the extreme lateral ends of the lateral markings tinged with yellow. Elsewhere the markings are a bright lemon yellow.

The flagellum is black, lighter below, especially at the base, and is but slightly carinate on segments 6–12, due to the presence of shallow longitudinal pits. The pubescence is conspicuous, white, and longest on frons, sides of thorax, propodeum, and base of legs. The legs are of normal form and the apical segment of the tarsi of the middle and posterior legs bears a small black maculation above, limited to the posterior half of the surface. The wings are hyaline. The second sternite bears a prominent median process. The genitalia resemble those of *duplicata*.

A single male paratype differs from the type in having the markings on the sternites less extensive, in having two instead of three yellow spots on the mesopleura, and in having a black spot below on the third pair of tibiae.

Length 16 mm. Described from two males, type and paratype, from San Luis Potosi, Mexico.

*Type*.—In the collection of Massachusetts Agricultural College, Amherst, Mass.

**STENIOLIA DUPLICATA** Provancher

Figures 7, 8

*Steniolia duplicata* PROVANCHER. Add. Faun. Canada. Hym., 1888, p. 414.—

PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 10.

*Steniolia scolopacca* HANDLIRSCH. Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl.,

vol. 98, 1889, p. 510.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 501.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 104, 1895, p. 965.

*Steniolia meridionalis* C. L. FOX, Proc. Calif. Acad. Sci., vol. 12, 1923, p. 430.

This appears to be the most widely distributed and certainly, with regard to the number of individuals, the most abundant species of the genus. It presents an unusually wide variation in the development of the maculations and also considerable variation in the shade of yellow present. Although the fundamental pattern shown by the maculations remains almost constant, it is difficult to find any two specimens on which the maculations are exactly alike. I have examined the type of C. L. Fox's *meridionalis* and in my judgment it is only a color variation of this species.

SPECIMENS EXAMINED

ARIZONA: Williams (July, Barber and Schwartz).

CALIFORNIA: Coalinga, Fresno County (June 3, 1907, J. C. Bradley); Diablo Range, Fresno County (June 2, 1907, J. C. Bradley); Jacumba Springs (July 29, 1911, W. D. Pierce); Los Angeles County; Yosemite (July 20, 1905, J. McFarland).

COLORADO: Arboles (C. F. Baker); Boulder (August 25, S. A. Rohwer).

IDAHO: Lewiston (C. L. Fox).

LOWER CALIFORNIA: San Jose Del Cabo.

MEXICO: Envir de Guadalajara, Jalisco (M. Diguët).

NEVADA: Reno (August 19, 1890, F. H. Hellman).

NEW MEXICO: Alamogordo (April 29, 1902); High Rolls (May 30, 1902); Las Cruces (May 17, S. Steel); Mesilla Park (C. N. Ainslie).

TEXAS: Marfa (June 5, 1908, Mitchell and Cushman).

UTAH: Lehi (September 9, 1905, W. A. Hooker).

WASHINGTON: North Yakima (July 7, 1903, Eldred Jenne).

WYOMING: Ritzville (July 29, 1922, M. C. Lane); Stratford (September 3, 1920).

STENIOLIA DISSIMILIS C. L. Fox

*Steniolia dissimilis* C. L. Fox, Proc. Calif. Acad. Sci., vol. 12, 1923, p. 429.

This species is very closely related to *Steniolia duplicata*. The males may be distinguished from the males of *duplicata* by the absence of pits on the segments of the flagellum. With regard to the females of this species, I have been unable to discover characters on which I could rely to separate them from the females of *duplicata*. Consequently the females of these two species are not separated from one another in the accompanying key to the species of this genus.

STENIOLIA ALBICANTIA Parker

*Steniolia albicantia* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 12.

This species was described from only male specimens and up to the time of the present writing no females have been discovered that can be associated with these males as sexes of one species. C. L. Fox, of San Francisco, has devoted considerable time to the study of the Bembicids and has collected extensively in the West. He writes me:

At Lake City, Modoc County, Calif., on the eastern side of the Warner Mountains, close to the Nevada border line, July, 1922, I collected a large series of what I determined as *albicantia*, and along with them I also took several males and females of typical *duplicata*. At Lewiston, Idaho (on the eastern border line of Washington), alongside of the Snake River, this summer (1925), I collected a series of *albicantia*, only males (similar to those from Lake City, Modoc County, Calif., in 1922) and with them in the same locality only females of *duplicata*. I did not come across a male *duplicata* during this trip.

I have never come across any white females to associate with *albicantia*, and in your description only males are described. The specimens of *albicantia* in my collection run to all sizes, robust and small.

I have seen some of the specimens collected by Mr. Fox at Lake City, Calif., and at Lewiston, Idaho, and they belong to *albicantia*. The data, however, that Mr. Fox has obtained from his work in the field and which he sets forth in his letter throw doubt on the validity of this species. I strongly suspect that the male of *duplicata* appears under two forms and that *albicantia* is simply a white form of the male of *duplicata*. More field work must be done and a fuller

knowledge of the biology of these wasps obtained before the question of the validity of species can be satisfactorily answered.

## SPECIMENS EXAMINED

CALIFORNIA: Lake City, Modoc County (July, 1922, C. L. Fox).

IDAHO: Lewiston (C. L. Fox).

WASHINGTON: Grand Coulee, Columbia River (July 12, 1902); Paha (July 25, 1923, M. C. Lane).

## STENIOLIA GUATEMALENSIS (Rohwer)

*Stictia guatemalensis* ROHWER, Proc. U. S. Nat. Mus., vol. 47, 1914, p. 517.

This species was described by Rohwer from two females from Guatemala but was referred to the wrong genus. The males that I have associated with these two females have the maculations white and have a pair of black marks, variable in size, on the clypeus. The maculations on the females are more yellowish but they are by no means so yellow as those of *longirostris*. Like that species, both males and females of this one have the hind femora black and ferruginous.

## SPECIMENS EXAMINED

ECUADOR: (C. T. Baker).

GUATEMALA: Antigua (W. P. Cockerell); Guatemala City (W. P. Cockerell).

SALVADOR: San Sebastian, Department of San Salvador (S. Calderon).

## RUBRICA, new genus

Figures 21, 22, 73

*Monedula* HANDLIRSCH and AUTHORS (part).

*Genotype*.—*Monedula gravida* Handlirsch.

Species belonging to this genus may be readily distinguished from those of other genera by the following combination of characters: Anterior ocellus a transverse, linear, arcuate cicatrice; maxillary palpus composed of six segments, labial of four; posterior lateral angles of propodeum rounded. In the case of the males the seventh tergite bears lateral spines; the eighth sternite ends in a single spine; the middle coxa bears a more or less well-developed posterior tooth, and the middle femur near its apex below bears a pair of flattened, roundly pointed teeth.

Head broad as thorax; eyes naked; anterior ocellus reduced to a cicatrice, transverse, arcuate; clypeus prominent, bulging, its basal half on median line strongly carinate, its apical portion strongly flattened; mandibles dentate; maxillary palpus composed of six segments, labial of four; posterior lateral angles of propodeum rounded.

its posterior surface somewhat concave; middle coxa of male bears a more or less well-developed posterior tooth; middle femur of male near its distal end below bears a pair of flattened, rounded teeth arising from a common base; posterior part of second sternite of male swollen and bearing a pair of rounded elevations; eighth sternite of male ends in a single spine; seventh tergite of male bears lateral spines; spatha of male genitalia as in Figure 73.

Species belonging to this genus have been reported from Mexico, North America, and from Brazil to Argentina in South America.

KEY TO THE SPECIES OF RUBRICA

1. Males (abdomen with 7 visible segments; antenna with 13 segments)-----2.  
Females (abdomen with 6 visible segments; antenna with 12 segments)-----4.
2. Anterior metatarsus bearing on its posterior border a series of rounded lobelike projections more or less black in color-----*gravida*.  
Anterior metatarsus not so formed-----3.
3. Sixth segment of the flagellum strongly excavated on its posterior side.  
**denticornis.**  
Sixth segment of flagellum not strongly excavated on its posterior side.  
**surinamensis.**
4. Sixth tergite without a well-defined carina; outline of tergite as in Figure 223-----*gravida*.  
Sixth tergite with well-defined carina; outline of sixth tergite otherwise-----5.
5. Line dividing upper area of clypeus from lower area a sharply-defined, angular ridge-----*surinamensis*.  
Line dividing upper from lower area of clypeus not sharply defined, rounded-----**denticornis.**

RUBRICA GRAVIDA (Handlirsch)

Figures 21, 22, 223

*Monedula gravida* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 121.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 497.

Of the known species of this genus *gravida* is the largest and most robust. The wings are uniformly and rather heavily infumated. The male of the species has the anterior metatarsus dilated and flattened with its posterior border bearing a series of rounded lobes usually black in color. The last two segments of the flagellum of the male (eleventh and twelfth) are strongly excavated below and the apex of the tenth below is drawn out into a stout tooth. The female lacks a median carina on the sixth tergite.

SPECIMENS EXAMINED

ARGENTINA: Buenos Aires (December 31, 1921).

PARAGUAY: Sapucay (March 29, 1903, W. T. Foster).

Handlirsch reports this species also from Rio Grande do Sul, Brazil.



## RUBRICA SURINAMENSIS (Degeer)

Figure 73

*Apis surinamensis* DEGEER, Mem. Hist. Ins., vol. 3, 1778, p. 569.*Monedula surinamensis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 115.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 500.

I have before me 50 specimens of this species and the variation among them with regard to color is quite extensive. This variation occurs with respect to the ground color as well as to the maculations. On some specimens the ground color is predominantly black; on others it is chiefly ferruginous; while on still others it is a combination of black and ferruginous. The maculations vary in color from light creamy yellow to much darker shades of yellow and on a few specimens the fasciae on the tergites show two shades, giving the appearance of double fasciae. There is a wide variation in the maculation of the scutum, especially on the females. At one extreme the scutum is black with only narrow lateral lines of ferruginous; at the other extreme the lateral lines are broad and yellow and there is present also a pair of very broad yellow discal lines, so that the black on the scutum is almost obliterated. Specimens having the scutum thus extensively maculated have the sides and ventral surface of the body wholly yellow. If I had representatives of only these two extremes I should be inclined to consider them as representing distinct species, but the series before me shows a well-marked gradation from one extreme to the other. Furthermore, some specimens having the scutum almost black have the sides and venter as decidedly yellow as those with the scutum almost entirely yellow.

## SPECIMENS EXAMINED

ARGENTINA: Carcarana (Brunner); La Rioja (B. P. Clark).

BOLIVIA: Corinas, Rio Beni (October, 1921, W. M. Mann); Rosario, Lake Rogogua (W. M. Mann); San Georgorio, Beni (October, 1921, W. M. Mann).

BRAZIL: Benevides, Para (October, 1918, S. M. Klages); Chapada; Obidos (August 14, 1919, Parish); Pernambuco (January 17, 1883); Suore Marajo, Para.

BRITISH GUIANA: Georgetown.

COLOMBIA: Bogota; Las Flores, Santa Marta (December 25, 1922).

DUTCH GUIANA.

PARAGUAY: Sapucay (February 24, 1903, W. T. Foster).

PERU: Piura (April 23, 1911).

TRINIDAD, S. A.

VENEZUELA: Maripa, Rio Caura (October, 1909, M. A. Carricker).

## RUBRICA DENTICORNIS (Handlirsch)

*Monedula denticornis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 99, 1890, p. 119.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 497.

This species so closely resembles *surinamensis* that it is with much difficulty that the two species can be separated. The males can be

distinguished by the character of the segments of the flagellum as Handlirsch has pointed out in his description of this species. The females of *denticornis* and *surinamensis* are almost identical. Handlirsch separated them from one another by the character of the ridge or boundary that divides the dorsal area from the ventral area of the clypeus, this boundary line being distinct and angular on *surinamensis* and indistinct and rounded on *denticornis*. It is a character difficult to use and of doubtful value, but I have been unable to discover anything better.

## SPECIMENS EXAMINED

ECUADOR: Pasorja.

MEXICO: Escuinapa, Sinaloa (J. H. Batty); Alta Mira, Tampa (June 22, 1903).

PERU: Lima (E. A. Martinez—Det. Rohwer); Lima (December 27, 1912, C. H. T. Townsend); Piura (April 28, 1911).

## Genus BEMBIX Fabricius

Figures 27, 28

*Apis* LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 574.

*Bembix* FABRICIUS, Syst. Ent., Char. Gen., 1775, No. 115.—PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 75.

*Bembyx* FABRICIUS, Syst. Ent., 1775, p. 361, No. 115.

*Bembex* FABRICIUS, Gen. Insect, 1776 (or 1777), p. 122.—OLIVIER, Encycl. Meth., vol. 4, 1789, p. 288.—FABRICIUS, Ent. Syst., vol. 2, 1793, p. 247.—LATREILLE, Gen. Crust. et Ins., vol. 4, 1809, p. 97.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 663.—KOHL, Ann. K. K. Naturhist. Hofmus., vol. 11, 1896, p. 430.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 501.

*Monedula* DAHLBOM, Hym. Eur., vol. 1, 1845, p. 492.

*Genotype*.—*Apis rostrata* Linnaeus, designated by Latreille in 1810; Morice and Durant (1915) concur in the designation.

Members of this genus are world-wide in distribution. They may be distinguished by the following combination of characters: Anterior ocellus reduced to a linear, transverse, arcuate cicatrice (traces of a lens present in a few species); posterior-lateral angles of the propodeum rounded, its posterior surface approximately flat; maxillary palpus composed of four segments, labial of two; first inter-cubitus more or less strongly bent.

Head wide as or slightly wider than the thorax; vertex depressed but slightly below the level of the top of the eyes; anterior ocellus (except in a few species) completely reduced to a linear, transverse, arcuate cicatrice; eyes naked; clypeus moderately arched, a broad, shallow median emargination on its apical border which is produced into a distinct point between the labrum and the base of the mandible; mandibles dentate; maxillary palpus composed of four segments, labial of two (on some individuals of certain species the number of segments in the palpi may vary); posterior-lateral angles



14. Middle femur dentate.....bidentata.  
Middle femur plain, or with a single tooth near the apical end bordering a well-defined notch.....15.
15. Middle femur plain; seventh tergite black.....tenuifasciata.  
Middle femur with tooth bordering a deep notch at apex; seventh tergite ferruginous.....mobii.
16. Seventh sternite conspicuously narrowed; process on sixth sternite a rounded, transverse swelling.....stenebdoma.  
Seventh sternite normal; process on sixth otherwise.....17.
17. Dorsum of abdomen almost wholly pale.....mediterranea.  
Dorsum of abdomen bearing only fasciæ, of which the first may be interrupted or reduced to lateral spots.....18.
18. Middle femur dentate below on apical half.....torosa.  
Middle femur plain.....19.
19. Terminal segment of antenna curved and truncate, its posterior apical angle pointed (fig. 162); seventh tergite black.....quinqvispinosa.  
Terminal segment of antenna not specially modified; apex of seventh tergite maculated.....pugillatrix.
20. Spine of eighth sternite ending in two points.....persimilis.  
Spine of eighth sternite ending in a single point.....21.
21. Anterior tibia bearing on inner side near apical end a slight depression between two black spots, the most distal one cup-shaped.....tenebrosa.  
Anterior tibia not bearing such characters.....22.
22. Middle metatarsus bearing a distinct lobelike dilation or swelling on its inner surface, usually at the middle or near the proximal end.....23.  
Middle metatarsus without such dilation or swelling.....26.
23. Basal part of wing infumated; apical part clear.....24.  
Wings clear, or uniformly infumated more or less.....25.
24. Fasciæ on tergites 1-5 yellow; sternites ferruginous.....doriae.  
Fasciæ on tergites 1-5 pale; only sternites 2 and 6 marked with ferruginous.....fuscipennis
25. Second sternite bearing a central ferruginous area; slender, less than 20 mm. in length.....stevensoni.  
Second sternite without ferruginous area; stout, 20 mm. or more in length.....refuscata.
26. Middle femur serrate or dentate (in some cases only two or three teeth near distal end).....27.  
Middle femur not serrate or dentate, smooth.....67.
27. Second and sixth sternites without distinct processes (in some species the second sternite may bear a more or less evident carina and the sixth may or may not bear a median blunt protuberance suggestive of a process).....28.  
Second sternite plain or weakly carinate; sixth with small median process and a pair of small lateral processes near the apex of the segment.  
insularis.  
Second sternite with distinct process; sixth plain.....sinuata.  
Second and sixth sternites with processes more or less well developed.....36.
28. Middle metatarsus distinctly curved, its inner surface beset with several stout spines.....29.  
Middle metatarsus not so formed.....30.
29. Mesosternum marked with black; sternites 2-4 mostly black; genital stipes as in Figure 217.....arcuata.  
Mesosternum yellow; sternites 2-4 almost wholly yellow; genital stipes as in Figure 218.....U-scripta.

30. Sixth and seventh tergites black.....31.  
 Sixth, or both sixth and seventh tergites, maculated.....33.
31. Fascia on second tergite continuous.....velox.  
 Fascia on second tergite interrupted.....32.
32. Clypeus with lateral borders black; tarsi more or less heavily suffused  
 with black above.....cinerea.  
 Clypeus wholly yellow; tarsi wholly yellow.....hinei.
33. Clypeus wholly black.....alacris.  
 Clypeus yellow.....34.
34. Seventh tergite with distinct lateral lobes (fig. 153).....35.  
 Seventh tergite without lateral lobes.....aldabra.
35. Seventh tergite notched at the apex (fig. 208).....trepanda.  
 Seventh tergite roundly pointed at the apex (fig. 153).....orientalis.  
 Seventh tergite squarely truncate at the apex (fig. 191).....seculata.
36. Process on sixth sternite prominent, its ventral surface flattened, bifurcate  
 at apex.....37.  
 Process on sixth sternite a transverse ridge, not sharply pointed but  
 slightly curved on each side of midline.....belfragei.  
 Process on sixth sternite prominent, very broad and thin, rounded distally,  
 almost a semicircle. (Intermediate segments of anterior tarsus dilated,  
 flattened, and marked with black).....integra.  
 Process on sixth sternite prominent, its ventral surface flattened, bluntly  
 pointed; pair of lateral processes on same sternite.....38.  
 Process on sixth sternite not as above, either relatively small or, if  
 flattened and roundly pointed, then the lateral processes on this sternite  
 are lacking.....43.
37. Spur on the middle tibia reaching to or beyond the middle of the meta-  
 tarsus.....amoena  
 Spur on middle tibia not reaching to or beyond the middle of the meta-  
 tarsus.....sayi.
38. Thorax, propodeum, and abdomen without maculations (Japan).....fumida.  
 Thorax, propodeum, and abdomen—one or more of these maculated.....39.
39. Narrow basal border of clypeus black.....40.  
 Basal border of clypeus otherwise.....41.
40. Scutum without discal marks.....oculata.  
 Scutum with well-developed (U-shaped) discal mark.....nigrocornuta.
41. Segments 8-12 of flagellum dilated and bluntly spinose on posterior border  
 (fig. 140).....miserabilis.  
 Segments of flagellum not as above.....42.
42. Prothorax not maculated; genital stipes as in Figure 112.....hamata.  
 Prothorax maculated in greater or less degree; genital stipes otherwise.  
 nubilipennis.
43. Anterior distal border of middle tibia produced into a spinelike process.....44.  
 Anterior border of middle tibia not so developed, normal.....46.
44. Middle tibia curved; middle metatarsus flattened at the apical end.  
 merceti.  
 Middle tibia not curved; middle metatarsus round.....45.
45. Large, 20 mm.; genital stipes as in Figure 182.....regnata.  
 Smaller, 15 mm.; genital stipes as in Figure 194.....spatulata.
46. Last three segments of antenna broad, flattened, and excavated below;  
 apical segment triangular in outline (fig. 159).....47.  
 Last three segments of antenna not as above.....48.

47. Seventh sternite with a longitudinal, median carina that is bifurcate at apex; spine of eighth sternite normal.....**rostrata**.  
Seventh sternite with simple median carina that does not reach the apex of the sternite; spine of eighth sternite short, straight, and broadly flattened.....**picticollis**.
48. Clypeus wholly or in part black, or bearing a pair of black spots.....49.  
Clypeus yellow or pale.....52.
49. Middle metatarsus with a pair of stout spines at its middle point below; distal half below somewhat curved.....**megerlei**.  
Middle metatarsus not as above.....50.
50. Clypeus and labrum (except lateral margins in some specimens) entirely black.....**melanopa**.  
Clypeus at most with a pair of black spots; labrum yellow.....51.
51. Scutum without discal marks; genital stipes as in Figure 98....**forcipata**.  
Scutum with well-developed discal marks; genital stipes as in Figure 100.....**frioensis**.
52. Seventh tergite as in Figure 148; genital stipes as in Figure 147....**ochracea**.  
Seventh tergite and genital stipes otherwise.....53.
53. Fascia on second tergite inclosing a pair of black spots; some or all pairs of lateral spots on sternites may be connected.....54.  
Fascia on second tergite not inclosing black spots; lateral spots on sternites not connected.....60.
54. Dorsum and posterior surface of propodeum immaculate; genital stipes as in Figure 91.....55.  
Dorsum and posterior surface of propodeum maculated; genital stipes otherwise.....56.
55. Seventh sternite terminating with a distinct median carina; fascia on first tergite alone interrupted.....**festiva**.  
Seventh sternite terminating with a distinct median notch; some or all fasciae on tergites (in addition to the first) interrupted.....**musicapa**.
56. Spine of eighth sternite flattened, resembling a spearhead (fig. 145).  
**niponica**.  
Spine of eighth sternite rounded, of normal form.....57.
57. Fascia on first tergite continuous; second sternite with broad apical fascia.....58.  
Fascia on first tergite interrupted; second sternite with only lateral spots (that may be connected with apical lines).....59.
58. Apical segment of antenna flattened and truncate at tip; scutum without discal marks.....**flavescens**.  
Apical segment of antenna rounded at tip; scutum with evident U-shaped discal mark.....**frioensis**.
59. Fasciae on tergites, except on first, continuous.....**connexa**.  
Fasciae on tergites all interrupted.....**frioensis**.
60. Narrow longitudinal and transverse discal lines on scutum; fascia on scutellum.....**aldabra**.  
Above combination of maculations on scutum and scutellum not present.....61.
61. Flagellum simple, none of its segments spinose or excavated.....**gradilis**.  
Flagellum with some of its segments spinose or excavated.....62.
62. Sides of propodeum and thorax (excluding prothorax) black; rarely small spot on mesopleura.....63.  
Sides of propodeum and thorax with conspicuous maculations.....66.

63. Fasciae on tergites narrow; usually (not always) all interrupted; ultimate tergite black.....*spinolae*.  
 Fasciae on tergites relatively broad, all but the first continuous; ultimate tergite maculated.....64.
64. Fifth segment of flagellum spinose; pubescence normal; process on sixth sternite short, broad, and roundly pointed; fasciae on tergites bright yellow.....*cameroni*.  
 Fifth segment of flagellum not spinose; process on sixth sternite narrow and sharply pointed; fasciae on tergites white or greenish yellow.....65.
65. Fasciae on tergites white.....*comata*.  
 Fasciae on tergites greenish yellow.....*primaestate*.
66. Scutellum with pair of large lateral spots.....*similans*.  
 Scutellum without lateral spots.....*primaestate*.
67. Process on sixth and second sternites lacking (second may sometimes show a median carina).....68.  
 Process on sixth sternite two approximated tubercles; seventh sternite a spine.....73.  
 Process on sixth sternite median and apical, supplemented by a pair of curved lateral carinae; prominent lateral carinae on seventh sternite.  
*liberiensis*.  
 Process on sixth sternite a simple median swelling, not carinate or pointed; that on second sternite small, median and pointed; thorax and propodeum entirely black and covered with long, dense, hoary pubescence.....*albata*.  
 Process on sixth sternite a transverse ridge extending entirely across the sternite, its median part broadly curved and brought to a sharp edge; process on second sternite prominent; intermediate segments of anterior tarsus greatly dilated.....*zonata*.  
 Process on sixth sternite variable in development, median, single, broadly triangular or narrow, pointed or notched at the apex; that on second more or less well developed, sometimes lacking.....74.
68. Clypeus marked with black.....69.  
 Clypeus not marked with black.....71.
69. Seventh segment of flagellum spinose; seventh sternite tricarinate.  
*formosana*.  
 Seventh segment of flagellum not spinose; seventh sternite with only a median carina.....70.
70. Sternites 2-4 with small lateral spots.....*kreichbaumeri*.  
 Sternites with yellow fasciae, much narrowed at the midline.....*raptor*.
71. Fasciae on tergites yellow, limited to 1-4.....*brullei*.  
 Fasciae on tergites pale, not limited to tergites 1-4.....72.
72. Seventh sternite ending in a spine.....*pruinosa*.  
 Seventh sternite not ending in a spine.....*comantis*.
73. Sides of thorax and propodeum black; yellow on tergites limited to lateral spots.....*beutenmulleri*.  
 Sides of thorax and propodeum almost entirely yellow; yellow fasciae on tergites continuous.....*occidentalis*.
74. One or more segments of flagellum spinose.....*infumata*.  
 Segments of flagellum not spinose.....75.
75. Clypeus black or bearing black spots.....*littoralis*.  
 Clypeus neither black nor bearing black spots.....76.
76. Propodeum black; fasciae on tergites limited to 1-4.....*brullei*.  
 Propodeum maculated more or less; fasciae on tergites not limited to 1-4.....77.

|  |                 |
|--|-----------------|
| 77. Fasciae on all tergites interrupted.....   | 78.             |
| Fasciae on tergites, some or all, continuous.....  | 80.             |
| 78. Sixth and seventh tergites maculated.....  | 79.             |
| Sixth and seventh tergites not maculated.....  | inops.          |
| 79. Scutum with broken U-shaped yellow discal mark; fasciae on tergites yellow.....  | frioensis.      |
| Scutum, at most, bearing small white discal lines; fasciae on tergites white.....  | multipicta.     |
| 80. Fasciae on tergites white with a trace of yellow on anterior margin; sternites 2-5 with broad, bright yellow fasciae almost completely covering them.....                      | flavolatera.    |
| Combination of fasciae on tergites and sternites as given above not present.....   | 81.             |
| 81. Metanotum black; fasciae on tergites creamy white.....   | 82.             |
| Metanotum maculated; fasciae on tergites yellow.....   | 83.             |
| 82. Fasciae on tergites continuous.....  | agrestis.       |
| Fascia on first tergite (and usually those on third and fourth) interrupted.....   | texana.         |
| 83. Front wing slightly infumated, most evident along the borders of the veins.....  | melanaspis.     |
| Front wing hyaline.....  | 84.             |
| 84. Scutum usually with pair of discal marks; dorsum of propodeum with curved yellow fascia.....   | troglydites.    |
| Scutum without discal marks; dorsum of propodeum black.....  | 85.             |
| 85. Process on second sternite prominent; lateral spots on second sternite connected.....  | helianthopolis. |
| Process on second sternite reduced, carinate in form; lateral spots on second sternite not connected.....  | bahiae.         |
| 86. Antennae and frons (except spot surrounding anterior ocellus) ferruginous or yellow suffused with ferruginous; tergites 1-5 with conspicuous maculations; length 22-25 mm..... | 87.             |
| Combination of characters as given above not present.....  | 88.             |
| 87. Scutellum, metanotum, and propodeum each bearing a fascia.....   | diversipennis.  |
| Scutellum, metanotum, and propodeum immaculate.....  | refuscata.      |
| 88. Neither metanotum nor dorsum or posterior surface of propodeum (excluding lateral angles) maculated.....   | 89.             |
| Metanotum or dorsum of propodeum or its posterior surface, any or all of these maculated.....  | 116.            |
| 89. Fasciae on all tergites interrupted medially (in some cases reduced to lateral spots or wholly lacking).....   | 90.             |
| Some or all of the fasciae on tergites continuous.....   | 103.            |
| 90. Ultimate tergite strongly wrinkled.....  | belfragei.      |
| Ultimate tergite not wrinkled, punctate (or rugose, in which case the labrum is abnormally long).....  | 91.             |
| 91. Clypeus heavily marked with black.....   | 92.             |
| Clypeus not marked with black.....   | 96.             |
| 92. Wings clear; length 15 mm. or less.....  | 93.             |
| Wings somewhat infumated; length greater than 15 mm.....   | 95.             |
| 93. Scape black; maculations of first and fifth tergites reduced to small widely separated lateral spots.....  | madecassa.      |
| Scape maculated below; maculations of first and fifth tergites interrupted fasciae.....  | 94.             |





|      |   |                       |
|------|---|-----------------------|
| 110. | Scutum and scutellum wholly black.....  | <i>integra</i> .      |
|      | Scutellum and sometimes the scutum with maculations, which may be quite small.....  | 111.                  |
| 111. | Fasciae on tergites yellow.....   | <i>similans</i> .     |
|      | Fasciae on tergites white.....  | <i>primaestate</i> .  |
| 112. | Fascia on first tergite continuous.....   | 113.                  |
|      | Fascia on first tergite interrupted.....  | 114.                  |
| 113. | Fascia on second sternite inclosing pair of black spots, or bearing pair of anterior emarginations; sixth sternite black.....                       | <i>brullei</i> .      |
|      | Fascia on second sternite not inclosing black spots or bearing emarginations; sixth sternite maculated.....   | <i>albata</i> .       |
| 114. | Fasciae on tergites bright yellow; ultimate tergite with central yellow maculation.....   | <i>cameroni</i> .     |
|      | Fasciae on tergites soiled or greenish white, rarely greenish yellow; sixth tergite black or with white (sometimes greenish yellow) maculation..... | 115.                  |
| 115. | Pubescence normal; sixth tergite black.....   | <i>spinolae</i> .     |
|      | Pubescence unusually abundant; sixth tergite with white (rarely greenish yellow) maculation, sometimes much obscured.....                           | <i>comata</i> .       |
| 116. | Lateral spots on sternites, at least those on sternite two, separated by a ferruginous area or band.....  | 117.                  |
|      | Lateral spots on sternites not so separated; ferruginous, if present at all, limited to apical lines.....   | 120.                  |
| 117. | Clypeus strongly carinate at base; second abscissa of the cubitella lacking.....  | <i>nupera</i> .       |
|      | Clypeus not strongly carinate at base; second abscissa of cubitella present (sometimes much reduced).....   | 118.                  |
| 118. | Fasciae on tergites yellow.....   | 119.                  |
|      | Fasciae on tergites pale.....   | <i>loupata</i> .      |
| 119. | Wings hyaline.....  | <i>capensis</i> .     |
|      | Wings infumated.....  | <i>stevensoni</i> .   |
| 120. | Labrum with median longitudinal carina whose distal part is broadened and longitudinally grooved.....   | <i>regia</i> .        |
|      | Labrum without such development.....  | 121.                  |
| 121. | Wings clouded medially or basally.....  | 122.                  |
|      | Wings not clouded medially or basally.....  | 125.                  |
| 122. | Clypeus not marked with black.....  | 123.                  |
|      | Clypeus black or marked with black.....   | 124.                  |
| 123. | Antennae ferruginous; legs marked with ferruginous.....   | <i>gracilens</i> .    |
|      | Antennae black and yellow; legs black and yellow.....   | <i>nubilpennis</i> .  |
| 124. | Maculation on mesopleura large and conspicuous; lateral spots on second sternite (sometimes on all sternites) united by apical line.....            | <i>melanaspis</i> .   |
|      | Maculation on mesopleura small or lacking; lateral spots on second sternite not connected.....  | <i>oculata</i> .      |
| 125. | Scutum with no trace of discal marks.....   | 126.                  |
|      | Scutum with more or less well-developed discal marks.....   | 143.                  |
| 126. | Large, 17-22 mm. in length.....   | 127.                  |
|      | Small, 16 mm. or less in length.....  | 134.                  |
| 127. | Fasciae on tergites yellow; second inclosing black spots.....   | 123.                  |
|      | Fasciae on tergites white or pale yellow; second never inclosing pair of black spots.....   | 129.                  |
| 128. | Clypeus yellow.....   | <i>occidentalis</i> . |
|      | Clypeus almost entirely black.....  | <i>recurva</i> .      |

129. Sixth tergite maculated.....131.  
Sixth tergite black.....130.
130. Anterior metatarsus bearing seven spines; fifth tergite with broad continuous fascia.....*pruinosa*.  
Anterior metatarsus bearing five spines; fifth tergite with widely separated lateral spots.....*quinqvispinosa*.
131. Sixth tergite bearing spinelike hairs, most numerous laterally (spinelike hairs on the apical border of fifth tergite also).....*sinuata*.  
Sixth tergite (and fifth) devoid of spinelike hairs.....132.
132. Scutellum bearing lateral spots.....*rostrata*.  
Scutellum bearing a fascia.....133.
133. Fasciae on all tergites continuous.....*miserabilis*.  
Fasciae on tergites 1-3 interrupted medially.....*liventis*.
134. Clypeus not marked with black.....140.  
Clypeus black or marked with black.....135.
135. Labrum yellow or pale.....136.  
Labrum black or marked with black.....138.
136. Sixth tergite maculated at apex.....*megerlei*.  
Sixth tergite black.....137.
137. Posterior metatarsus marked with black.....*formosana*.  
Posterior metatarsus entirely yellow.....*oculata*.
138. Mesopleura and metapleura well maculated.....*helianthopolis*.  
Mesopleura and metapleura black (rarely small spot on mesopleura).....139.
139. Fascia on the fifth tergite continuous.....*velox*.  
Fasciae on the fifth tergite interrupted.....*melanopa*.
140. Fascia on first tergite continuous; fasciae on tergites pale.....*merceti*.  
Fascia on first tergite interrupted (sometimes continuous, in which case fasciae on tergites are yellow).....141.
141. Fasciae on tergites yellow.....*similans*.  
Fasciae on tergites pale.....142.
142. Interrupted fascia on dorsum of propodeum.....*inops*.  
No fascia on dorsum of propodeum.....*primaestate*.
143. Deep median transverse notch on front of labrum (fig. 135).....*mima*.  
Transverse notch lacking, at most a median prominence on labrum.....144.
144. First intercubitus vein but slightly bent (fig. 220).....145.  
First intercubitus vein normal.....149.
145. Anterior ocellus normal; that is, reduced to a cicatrice.....146.  
Anterior ocellus not completely reduced to a cicatrice, lens present, though distorted.....148.
146. Clypeus bearing pair of small black spots.....*regnata*.  
Clypeus without black spots.....147.
147. Sixth tergite and sixth sternite maculated.....*persimilis*.  
Sixth tergite and sixth sternite black.....*hexaspila*.
148. Lateral spots on sternites 2-5; apex of sixth sternite yellow.....*U-scripta*.  
Lateral spots on sternites 2-4; sixth sternite black.....*arcuata*.
149. Mandibles slender, teeth reduced to a single vestige; all tergites and all sternites (including apical part of sixth) with continuous fasciae.....*occidentalis*.  
Mandibles with at least one evident tooth; maculations of tergites and sternites not as given above.....150.
150. Labrum unusually long (fig. 215); ultimate tergite rugose (fig. 216).....*rugosa*.  
Labrum normal; ultimate tergite punctate.....151.

|  |                       |
|--|-----------------------|
| 151. Clypeus black or marked with black.....   | 152.                  |
| Clypeus not marked with black.....   | 173.                  |
| 152. Apical part of the terminal segment of all tarsi black above: no black above elsewhere on tarsi.....  | <i>torosa</i> .       |
| Apical part of the terminal segment of all tarsi not black above; or if so, then other parts of tarsi also black above.....  | 153.                  |
| 153. Fasciae on all tergites interrupted medially.....   | 166.                  |
| All or at least some of the fasciae on tergites continuous.....  | 154.                  |
| 154. Anterior metatarsus dilated and flattened (fig. 219).....   | 155.                  |
| Anterior metatarsus normal.....  | 156.                  |
| 155. Dorsum of propodeum bearing a well-developed fascia.....  | <i>borneana</i> .     |
| Dorsum of propodeum without fascia.....  | <i>palmata</i> .      |
| 156. Fasciae on tergites 1-5 continuous, or all continuous except that on fifth tergite.....   | 157.                  |
| Fasciae, except that on first tergite (and sometimes that on fifth tergite also), continuous.....  | 168.                  |
| 157. Labrum black or with medial black stripe.....   | 158.                  |
| Labrum not marked with black.....  | 159.                  |
| 158. Sides of thorax with conspicuous maculations.....   | <i>levis</i> .        |
| Sides of thorax black or with only inconspicuous pale maculations.....   | <i>velox</i> .        |
| 159. Scape entirely black.....   | 160.                  |
| Scape with maculation below, sometimes very small.....   | 161.                  |
| 160. Scutum with unbroken U-shaped discal mark; mesopleura bearing large yellow maculation.....  | <i>nigrocornuta</i> . |
| Scutum with pair of discal lines (rarely with broken U-shaped mark); mesopleura black or with small spot below wings.....  | <i>oculata</i> .      |
| 161. Second and third sternites with broad fasciae.....  | <i>seculata</i> .     |
| Second and third sternites with lateral spots (sometimes connected by fine apical lines).....  | 162.                  |
| 162. Frons wider than the eye viewed from in front; that is, the frons makes up more than one-third of the total width of the head.....  | 163.                  |
| Frons not wider than the width of the eye seen from in front.....  | <i>orientalis</i> .   |
| 163. Posterior orbits very broad and above extended mesad on the occiput beyond the inner margins of the eyes at the vertex; proboscis when at rest not wholly retracted beneath the labrum..... | <i>spiritalis</i> .   |
| Posterior orbits not usually broad and not extended beyond the inner margins of the eyes; proboscis when at rest completely retracted beneath the labrum.....                                    | 164.                  |
| 164. Length 18-20 mm.....  | <i>melancholica</i> . |
| Length less than 18 mm.....  | 165.                  |
| 165. Fasciae on tergites yellow; first roundly biemarginate on anterior dorsal border.....   | <i>borrei</i> .       |
| Fasciae on tergites pale; first not biemarginate on anterior border.   | <i>opinabilis</i> .   |
| 166. Black on clypeus in form of basal spots, entirely separate or united at base of clypeus; terminal segment of tarsi without dusky spot above.....  | 167.                  |
| Black on clypeus a solid band or covering the entire clypeus; terminal segment of tarsi with dusky spot above.....   | <i>multipicta</i> .   |
| 167. Lateral spots on sternites prominent and extending along apical margin of sternite toward midline or joined by apical lines.....  | <i>frioensis</i> .    |
| Lateral spots on sternites much reduced or lacking; not connected by apical lines.....   | <i>pugillatrix</i> .  |

168. Ultimate tergite black.....169.  
 Ultimate tergite maculated.....170.
169. Labrum black.....*heiianthopolis*.  
 Labrum not black.....*opinabilis*.
170. Small, 17 mm. or less in length.....171.  
 Large, 20 mm. or more in length (African).....*longipennis*.
171. Discal mark on scutum in form of broad unbroken U; maculation of sixth tergite a pair of lateral spots.....172  
 Discal mark on scutum not in form of unbroken U; maculation of sixth tergite an apical spot.....*troglydites*.
172. Second sternite wholly yellow; sixth sternite maculated.....*latifasciata*.  
 Second sternite with large median black spot; sixth sternite black.....*laeta*.
173. Dorsal border of clypeus at the midline extended upward in the form of an angle whose apex is above the lower level of the insertion of the antennae; second sternite uniformly and finely punctate with a very few somewhat larger punctures interspersed.....*bellatrix*.  
 Clypeus and second sternite not developed as given above.....174.
174. Discal mark on scutum in form of U, complete or broken (sometimes only the posterior transverse spots remain).....175.  
 Discal mark on scutum a pair of narrow longitudinal lines.....186.
175. Sixth tergite showing well-developed lateral ridges.....*generosa*.  
 Sixth tergite with weakly developed lateral ridges or with none at all.....176.
176. Second and third sternites broadly banded with yellow.....177.  
 Second and third sternites not broadly banded with yellow, but bearing lateral spots.....180.
177. Fasciae on all tergites continuous.....178.  
 Fasciae on all tergites, or on all but the second tergite, interrupted.  
*pirapora*e.
178. Ultimate tergite yellow (bearing a single maculation).....179.  
 Ultimate tergite bearing pair of lateral maculations.....*trepanda*.
179. Fascia on first tergite with pair of black spots almost inclosed; length 17 mm.....*latifrons*.  
 Fascia on first tergite showing only broad, shallow, anterior emarginations; length 14 mm.....*spatulata*.
180. Fasciae on all tergites interrupted (on some specimens that on second tergite is continuous, but greatly narrowed at midline).....*insularis*.  
 Fasciae on tergites usually all continuous (on one species the fasciae on first tergite and on another species those on third and fourth tergites interrupted).....181.
181. Propodeum, especially its lateral angles, covered with long dense pubescence (maculations pale faded yellow).....*mediterranea*.  
 Propodeum showing only normal pubescence.....182.
182. Length 15 mm. or less.....183.  
 Length greater than 15 mm.....184.
183. Both tergite and sternite of sixth abdominal segment maculated.....*raptor*.  
 Neither tergite nor sternite of sixth abdominal segment maculated.....*fucosa*.
184. Mesosternum black.....*sayi*.  
 Mesosternum maculated.....185.
185. Sixth tergite black.....*taiwana*.  
 Sixth tergite maculated.....*incognita*.
186. Fasciae on tergites white or pale.....*primaestate*.  
 Fasciae on tergites yellow.....187.

|  |                    |
|--|--------------------|
| 187. Fascia absent on metanotum.....   | 188.               |
| Fascia present on metanotum.....   | <i>similans</i> .  |
| 188. Fasciae on all tergites continuous.....   | <i>zonata</i> .    |
| Fasciae on first tergite always interrupted; sometimes other fasciae also interrupted..... | <i>muscipapa</i> . |

**BEMBIX REGIA, new species**

Figures 172-178

*Type* (male).—Black: labrum except median stripe; mandibles, except tips; narrow apical border and lateral spots on clypeus; small spot on scape below; small round spot on either side of anterior ocellus; minute spot between antennae; posterior orbits broad below, narrow above; posterior border of pronotum; sides of prothorax almost entirely; narrow lateral line on scutum above base of wings; curved, interrupted fascia on posterior border of scutellum; interrupted fascia on metanotum; curved fascia on propodeum, broadest on posterior surface; lateral angles and almost entire sides of propodeum; large spot on metapleura; mesopleura and mesosternum almost wholly; widely separated lateral spots on first tergite, broad at lateral end and narrowed to a point at dorsal end; continuous fasciae on tergites 2-4, that on second almost inclosing a pair of discal spots, those on third and fourth biemarginate on anterior border; lateral spots on tergites 5 and 6; lateral spots on sternites 2-5; legs except black line above on anterior femora, black line below and broken line above on anterior tibiae, black spot above at base of the other tibiae and black spot below on each segment of anterior and middle tarsi; *yellow*. On some parts of the body the yellow has a greenish tinge and the dorsal part of the tergal fasciae is pale.

The antennae are stout, the scape being unusually thick and heavy. Segments 9-11 of the flagellum are broadened and flattened below but are not much excavated, the surface being only slightly concave. The apical segment is rounded, slightly curved and truncate at the apex. The spines of the anterior metatarsus, of which one bears seven and the other six, are peculiar in form, most of them, but not all, being broad, flat, and stout (fig. 177). The intermediate femora are dentate, each bearing at the base a single stout spine and apical to this a series of very small spines. The middle tibia on its inner side shows a slight swelling at the apical end. The middle metatarsus is strongly curved and compressed. Below at its proximal end is a slight protuberance covered with fine stiff hairs and the anterior border at the apical end is developed into a broad, thin, wedgelike process (fig. 174). This is true also of the second segment, and to a less degree of the third. The second sternite bears a

prominent carina and the sixth a very narrow median process, whose ventral surface is concave and whose apex resembles a carina. It does not reach the apex of the sternite. The seventh sternite bears a median carina. The sides of the seventh tergite are gently sinuate and the apex is broad and round. Lateral ridges are present but not at all prominent. The eighth sternite ends in a relatively short, curved, hirsute spine that, near its middle, is much dilated along its dorsal margin (fig. 178).

*Allotype* (female).—Black: narrow dorsal border and broader lateral borders of labrum; very narrow border and narrow lateral stripe on clypeus; pair of small spots between antennae; pair of rounded spots near anterior ocellus; trace of anterior orbits opposite antennae; posterior orbits broad below, narrowed and shortened above; posterior border of pronotum; side of prothorax, except large lateral spot that covers much of the tubercle; narrow lateral lines and narrow, transverse discal line on scutum; narrow fascia on posterior border of scutellum; narrow fascia on posterior border of metanotum; curved fascia on propodeum, widened and interrupted on its posterior surface; spot on posterior lateral angles extended to form an interrupted fascia on ventral part of posterior surface of propodeum; vertical anterior stripe on side of propodeum; metapleura almost entirely; triangular spot with longer leg vertical and shorter leg longitudinal on mesopleura; widely separated lateral spots on first tergite; fascia on second tergite, notched at midline on anterior border, broadly emarginate on median posterior dorsal border, and enclosing a pair of elliptical black spots; fascia on third tergite similar to that on second but with emarginations representing the discal spots; narrow, interrupted fascia on fourth tergite; small widely separated lateral spots on fifth; small lateral spots on sternites 2-4; line above and below on femora; tibiae, except black line above and below; and tarsi, except black spot below on anterior metatarsus; *yellow*.

The flagellum is black with a fuscous line below on all segments. The wings are slightly and uniformly infumated. The anterior metatarsus bears six broad, black spines whose dorsal surface is concave. The disk of the second sternite is smooth and shining and bears scattered coarse punctures. The sixth tergite is roundly triangular at the apex and is densely punctate except at the extreme posterior end. The labrum bears a distinct longitudinal carina that broadens near the apex where it is distinctly grooved (figs. 172, 173).

The paratype differs but slightly from the allotype; the clypeus, frons, and labrum have less yellow on them and the carina of the labrum is less conspicuous at the base.

Length 17 mm. Described from a male bearing the label "Neu-Kamerun No. 218-21 Tessmann S. S.," and two females with the label, "Leubo Congo. D. W. Snyder."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

*Allotype*.—Cat. No. 40837, U.S.N.M.

BEMBIX MIMA Handlirsch

Figures 134-137

*Bembex mima* HANDLIRSCH, Sitz Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 795.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 508.

Of this species I have before me two specimens, a male bearing the label "Mexico, Distrito Federal, J. R. Inda, Collector," and a female bearing the label, "Guadalajara, Jalisco, Mex., IX, 14, McClendon." This species is distinguished by the presence on both sexes of a prominent median transverse notch on the labrum and of a well-defined apical pygidial area on the last tergite, set off by short but evident lateral ridges. Handlirsch described this species from a single female and I am therefore giving below a detailed description of these two specimens.

*Male*.—Black: Labrum; mandibles, except tips; clypeus, except narrow basal border; scape below; spot between antennae; broad but short anterior orbits; broad posterior orbits narrowed and abbreviated above; spot on side of prothorax; fascia on posterior border of prothorax including tubercles but interrupted dorsally at midline; narrow lateral line on scutum above base of wings; narrow curved fascia enlarged laterally on scutellum; narrow curved fascia on metanotum; spot on metapleura; fascia on first tergite broken into lateral spots and median dorsal spot; fasciae on second and third tergites interrupted medially and emarginate on anterior border on either side the middorsal line; fasciae on fourth, fifth, and sixth tergites broken into spots; large median spot on apex of seventh tergite; small lateral spots on second sternite; anterior border of femora of first pair of legs; anterior distal end of femora of second and third pairs; all tibiae, except black line on posterior border; and tarsi; *yellow*.

The female closely resembles the male but with the maculations a little more extensive. The black on the clypeus is restricted to a pair of small spots; there is a broken U-shaped discal mark on the scutum; a broad interrupted fascia on the propodeum and a spot on its side; the mesopleura almost entirely yellow; and lateral spots on sternites 2 and 3. In other respects the maculations are very similar to those on the male.



The flagellum is black above, yellow or ferruginous below, and segments 8–11 of the male are somewhat prominent on their posterior distal border but can not be termed spinose. The labrum bears a prominent, transverse median notch whose lower border assumes somewhat the form of a tooth. The sixth tergite of the female and the seventh of the male bear an evident apical pygidial area set off by short lateral ridges. The anterior metatarsus is provided with eight spines. The infumation of the wings is slight, although a little more evident in the female and a little more uniform than in the male. The pubescence is short and fairly dense on the head, thorax, and propodeum; gray on the head, sides of thorax, and on the propodeum; brownish on the scutum. The posterior border of the middle femur of the male does not bear evident teeth or spines. The second sternite of the male bears a prominent median process and the sixth a conspicuous, short, median tooth bluntly rounded at the point. The genital stipes is distinct in form as shown in Figure 136.

BEMBIX TAIWANA Bischoff

*Bembix taiwana* BISCHOFF, Deutsch. Ent. Zeitschr., Heft., 7, 1913, p. 712.

Of this species I have before me a male and a female identified by Bischoff. The pubescence on the head, thorax, and propodeum of the male is almost white, not unusually long but unusually dense, especially on the scutum. The scutum, except for very inconspicuous lines above the base of the wings, is entirely black; the scutellum bears a narrow fascia; the maculations of the metanotum, the propodeum, and the sides and venter of the thorax are so extensive as to render these parts almost devoid of black. The color is a pale, clay-colored yellow. The tergites are wholly of this color, the first, second, third, and fourth each bearing a pair of much reduced, transverse, black spots or lines. Segments 10 and 11 of the flagellum bear prominent excavations, and 7–9 are somewhat spinose. The posterior border of the middle femur is smooth but is much compressed and wedgelike. The second sternite shows only a trace of a carina and the sixth a low, roundly-pointed, triangular prominence. The seventh tergite is deeply emarginate at the apex and at the base there is a pair of short but distinct lateral ridges whose posterior ends do not form spines or sharp angles.

The color on the female is a more decided yellow. The scutum bears a pair of posterior, median discal marks; the fascia on the scutellum is interrupted; and the yellow on the metanotum and dorsum of the propodeum is less extensive than on the male. The side of the thorax and the propodeum are similar to those of the male. The fasciae on the tergites are less extensive than those on

the male, leaving a black posterior border on each tergite. The sixth tergite is black and the maculations on sternites 2-5 are reduced to lateral spots. The two specimens bear a common label, "S. Formosa, Taihanroku, 3.-10. VIII. 08, Sauter."

BEMBIX FUCOSA, new species

Figures 104-106

*Type* (male).—Black: labrum; mandibles, except tips; clypeus; frons below anterior ocellus, except pair of large black spots; scape, except spot above; anterior orbits deflected inward and interrupted at anterior ocellus; posterior orbits broad below, narrow above; prothorax almost wholly; broad lateral lines and broken U-shaped mark on scutum; narrow fascia on posterior border of scutellum enlarged laterally; fascia on metanotum; prominent curved fascia on posterior and dorsal surface of propodeum; lateral angle and side of propodeum; metapleura and mesopleura almost entirely; fasciae on tergites 1-5 continuous, on 6 interrupted; first fascia narrowed dorsally and bisinuate dorsally on anterior border; second inclosing a pair of elliptical black spots and deeply and acutely emarginate on posterior border at dorsal midline; third similar to second but with dorsal elliptical spots not entirely enclosed; fourth and fifth bisinuate on anterior margin and very deeply and acutely emarginate on posterior margin at midline; lateral spots on sternites 2-5, those on sternites 2 and 3 almost united by apical prolongations; legs, except black anterior spot on middle and posterior coxae, black spot on trochanters, black line above on anterior femur, and black spot below on all tibiae; *creamy white or bright yellow*. The maculations on the head (except the frons in part and the lower part of the posterior orbits), the posterior line on scutum, fasciae on scutellum and metanotum, and the dorsal part of the fasciae on the tergites are pale, creamy white. The longitudinal discal lines on the scutum and the lower part of the large spot on the mesopleura are decidedly rufous. Elsewhere the maculations are yellow.

The antennae are dark above, fuscous below. Segments 7-10 of the flagellum are dilated and obtusely prominent on posterior margin. Segments 9-11 are excavated below and segment 12 is flattened toward the apex, roundly pointed and strongly curved. The middle femur is dentate below. The second sternite bears a prominent, compressed, bluntly pointed process. The process on the sixth sternite is peculiar in that its base is a transverse swelling, from the median part of which a carina, broad at base but narrowed to an edge at apex, extends in a curve to the apical margin of the sternite. The seventh sternite is strongly carinate on midline. The seventh tergite bears conspicuous lateral ridges and is roundly pointed at the apex.

The *allotype* (female) in the character of its maculations differs but little from the type. The anterior orbits are not interrupted and are continuous with the posterior orbits; the U-shaped discal mark on the scutum is broader and unbroken; the fasciae on the tergites are all continuous, broader than on the type, and both second and third inclose paired black spots. The yellow of the maculations is more intense than on the type, only the clypeus, frons, and labrum showing evidence of creamy white. Like the type, the discal mark on scutum and the spot on mesopleura show a strong rufous coloration. The disk of the second sternite is smooth and shining and bears scattered coarse punctures. The sixth sternite is slightly carinate.

The wings in this species are hyaline, and the second abscissa of the cubitella is absent or rudimentary. The pubescence is of normal character. The anterior metatarsus bears seven spines. The frons between the antennae and the basal part of the clypeus are carinate. On one female paratype the fascia on the first tergite bears a pair of rounded black spots and on one male paratype the fascia on the fifth tergite, as well as that on the sixth, is interrupted at midline.

Length 15 mm. Described from three males and four females, of which number six bear the label "Ober-Burma, Mandalay, 26. 8. 00, Coll. Bingham." The seventh (a female) bears the same label but with the date reading "2. 9. 00."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

BEMBIX LOUPATA, new species

Figures 123-126

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except pair of small black spots; frons between antennae; pair of small spots on frons near anterior ocellus; scape below; broad but short anterior orbits; posterior orbits narrowed above; posterior border of pronotum; side of prothorax, except black spot that includes most of tubercle; small lateral spot on scutum above base of wings; fascia on scutellum reduced to narrow widely separated lines; narrow elongated spot on mesopleura; fascia on first tergite interrupted and parts narrowed to a point at mid-dorsal line; fascia on second broad laterally, widely, and deeply emarginate (the emarginations prolonged to right and left) and acutely notched on anterior border and slightly emarginate at midline on posterior border; fasciae on third and fourth tergites similar to that on second but with emarginations less pronounced; that on fifth tergite broad and only slightly narrowed at midline; that on sixth also broad and almost interrupted at midline; lateral spots on sternites 2-6 connected by apical lines, except those on sternite 6; femora, except

above and below basally; tibiae, except spot below on anterior pair and basally above on all; and tarsi; *pale with a tinge of yellow* on the labrum and on the lateral portions of the tergal fasciae. The anterior part of the apical lines connecting the lateral sternal spots is tinged with ferruginous.

The flagellum is dark above, lighter below, and at the apex takes on a ferruginous appearance. Segments 9, 10, and 11 are slightly excavated below, and 7 and 8 are spinose. The ultimate segment is slightly curved, somewhat flattened and pointed at the apex. The middle femur below is beset with several sharp-pointed teeth that are longest near the apex of the femur, which on its posterior surface bears a distinct longitudinal depression or groove. The second sternite bears a long, low, thin carinalike process that ends in a blunt point. The sixth sternite is peculiar in that it bears a median triangular swelling that can not be termed a process, since its apical part slopes smoothly to the apical margin of the sternite, which shows a slight median apical emargination. The seventh sternite shows a prominent median carina and is distinctly notched at the apex. The seventh tergite on either side bears a distinct lateral ridge with an emargination producing a lateral angle and bears within this angle several short spinelike hairs. The apex of the tergite is relatively broad and roundly truncate.

*Allotype* (female).—Black: labrum; mandibles, except tips; apical border of clypeus; spots on frons; scape and flagellum below; anterior and posterior orbits; apex of sixth tergite; sixth sternite; fasciae joining lateral spots on sternites; legs except basal segments and more or less of the basal part of all femora; *ferruginous*. Narrow line on posterior border of pronotum; posterior part of tubercle; narrow fascia on posterior border of scutellum; narrow fascia on metanotum; narrow abbreviated fascia on propodeum; small spot on lateral angles of propodeum; continuous fasciae on tergites 1–5: first narrowed medially; second inclosing pair of dorsal black spots; third, fourth, and fifth biemarginate on anterior dorsal border and acutely sinuate at mid line on posterior border; and lateral spots on sternites; *pale*. Traces of yellow are seen on the labrum, on the extreme lateral portions of the tergal fasciae and on the tibiae. The sixth sternite is carinate on the mid line and the sixth tergite, which is narrow and rounded at the apex, is covered with spinelike hairs very prominent laterally at the base.

Length 14–16 mm. Described from three specimens. The type and allotype bear the label, "Deutsch Ost Afrika, Kanoga, Fr. Muller S." A second female, which I have referred to this species, bears the label, "Victoria-Nyansa, I. Ukerewe, Conrads S. G." This differs from the allotype in having the labrum light yellow, the abdominal fasciae brighter with a creamy yellowish tinge. The ferruginous fasciae

connecting the lateral sternal spots are much obscured and the propodeum is wholly black.

*Type* (male).—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX RESIDUA, new species**

Figs. 184–186

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except pair of large basal black spots; scape below; frons between and above insertion of antennae, except pair of narrow vertical lines between antennae; broad, short anterior orbits; posterior orbits narrowed above; posterior border of pronotum; side of prothorax almost entirely; spot on tegula; small lateral spot on scutum at base of wings; small lateral spots on scutellum; fascia on anterior border of metanotum not reaching its lateral margins; broad curved fascia on dorsum and posterior surface of propodeum; lateral angles and nearly the entire sides of propodeum; metapleura: mesopleura, except black spot behind tubercle and another in front and above middle coxa; mesosternum; very broad fasciae on tergites 1–6; fascia on first tergite broadly and shallowly bisinuate on anterior dorsal margin and more deeply and more acutely bisinuate on posterior dorsal margin; second and third fasciae each inclosing a pair of narrow, elongated, elliptical dorsal black spots and somewhat irregular on dorsal margin; fourth and fifth each biemarginate on anterior dorsal border and slightly emarginate on posterior border at midline; sixth slightly bisinuate on anterior border, slightly emarginate at midline on posterior border, and shortened laterally; seventh tergite, except basal lateral black areas; lateral spots on sternites 2–6; legs, except spot below on posterior coxae, spot on all trochanters, line above on all femora, line above and below on all tibiae, and spot below on each segment of all tarsi; *pale or soiled yellowish white*.

The flagellum is black and segments 8 and 9 are spinose. Segments 10 and 11 are excavated below and are somewhat dilated. Segment 12 is very slightly curved and is rather sharply pointed at the apex. The frons between the antennae and to a less extent the basal part of the clypeus are carinate. The anterior metatarsus is provided with six spines, of which the proximal one is quite small. The middle femora are weakly serrato-dentate. The process on the second sternite is a low median carina ending posteriorly in a short blunt point. The sixth sternite bears a low broadly triangular, obtusely pointed process and the seventh is strongly carinate on the midline. The seventh tergite, which is slightly sinuate laterally, truncate apically, and slightly emarginate at apical midline, bears short but evident lateral ridges. The wings are very slightly but uniformly infumated. The pubescence is short, dense, and gray on

head, thorax and propodeum, except on the scutum and scutellum, where it is unusually short and brown in color. The sixth tergite, and to a less degree the fifth and fourth also, are covered with relatively long black pubescence. The inner eye-margins are slightly divergent at the clypeus.

This species stands close to *B. taiwana* Bischoff from which it differs in the character of its maculations, in the character of the pubescence on the scutum, and in the better development of the processes on sternites two and six.

Length 22 mm. Described from a single male bearing the labels, "China. Tsha-jiu-san, V.-VI. 12, Mell S. V.," and "Berggebiet i. N. v. Kuangtung, Bambuswald, ca. 1400 m Hoch."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX RECURVA, new species**

Figures 165-168

*Type* (male).—Black: lateral borders of labrum; narrow apical band and extreme lateral borders of clypeus; short anterior orbits broadened just above insertion of antennae; broad posterior orbits, narrowed above and not extended to vertex; spot on side of prothorax extending to tubercle; median bilobed spot on postero-dorsal surface of propodeum; lateral angles of propodeum; spot on anterior part of mesosternum; broad fascia on first tergite enclosing a round black spot near anterior margin on left side of midline and having a broad rounded anterior emargination on right side; broad fascia on second tergite inclosing pair of elliptical dorsal spots; narrow fascia on third tergite greatly shortened at the side; pair of lateral spots on second sternite; femora in part; tibiae, except line above on first pair and line below on second and third pairs; tarsi, except apical part of terminal segment of all pairs and posterior border of metatarsus of first pair; *yellow*.

The flagellum is black above but not wholly so below, and segments 7, 8, and 9 are slightly spinose. Segments 10, 11, and 12 are slightly excavated, and 12 which is as long as 10 and 11 combined, is curved, and is also narrowed toward the apex, which is roundly pointed. The posterior border of the middle femur is somewhat undulate and near its distal end bears two blunt rounded teeth. The second sternite bears a weakly developed median process and the sixth a well-developed, narrow, flattened, bluntly pointed process that extends slightly beyond the apex of the sternite. The seventh tergite is broadly and bluntly rounded at the apex. It is slightly sinuate laterally and bears a pair of lateral ridges that stand out prominently when the tergite is viewed from the side.

*Allotype* (female).—Black: extreme apical, lateral angles of clypeus; spot below on scape; spot on either side anterior ocellus; *obscure yellow*. Posterior orbits not reaching vertex; narrow line below tubercle on prothorax; fascia narrowed laterally on posterior surface of propodeum; lateral angles of propodeum; broad fascia on first tergite with broad, shallow, median anterior emargination; fascia on second tergite inclosing a pair of elliptical dorsal black spots; small lateral spots on second sternite; femora apically in part; anterior surface of anterior tibiae; outer surface of middle and posterior tibiae; *bright creamy yellow*. The yellow of the tarsi is obscured by brownish or ferruginous. The posterior surface of the anterior metatarsus, as in the type, is black. The sixth tergite is bluntly rounded at the apex. The sixth sternite bears numerous coarse punctures, especially near the apex, among which are many very fine punctures. The second sternite is slightly carinate on the midline, shining and provided with scattered coarse punctures.

The wings in this species are hyaline and the pubescence is very short and inconspicuous. The posterior lateral angles of the propodeum are unusually prominent in this species, giving the posterior surface of this segment somewhat the shape and appearance found in the genus *Bicyrtes*.

I have assigned to this species two other males that differ markedly from the type in the extent of their maculations. On each of these the labrum is wholly yellow; the clypeus bears only a small pair of black spots; the prothorax is almost wholly yellow; there are lateral spots on the scutellum, a fascia on the metanotum, a curved fascia on the propodeum, and a small spot on the mesopleura. On one there are broad fasciae on the first six tergites, the second inclosing black spots, whereas on the other the fasciae are limited to the first three tergites, the second fascia inclosing black spots. I have placed these specimens in this species in spite of the fact that they differ so widely in the extent of their maculations and are slightly larger in size, because I can find no essential difference in the morphological characters of the three males and because no two of them agree in the extent of their maculations.

Length, 22 mm. Described from three males and one female. The type<sup>5</sup> and allotype are from Neu-Kamerun, collected by Tessimann.

<sup>5</sup> The specimen designated as the type of this species is in bad condition. When received for study the sixth and seventh abdominal segments were completely retracted so that the specimen had to be relaxed before it could be studied. At some previous time it had decomposed to such an extent that not only has the color faded but as soon as it was relaxed it fell into pieces and had to be reassembled after the genitalia had been extracted and the terminal abdominal segments extended. After the description had been written the genitalia of the type, through an unhappy accident, was lost, but not before the author had made a careful comparison of the genitalia of the type and paratypes and assured himself that there were no differences between them discernible.

The two paratypes (males), collected by Riggenbach, bear the following labels: The one, "Kamerun int. Garua." and the other, "Kamerun Tsad-See a. Benne unterh. Garua."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX LEVIS, new species**

Figures 116–118

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except a pair of elliptical spots; scape below; spot between and above antennae; broad anterior orbits shortened above; posterior orbits narrowed above; posterior dorsal border of prothorax; sides of prothorax almost entirely; spot on tegula; narrow line on scutum above tegula; curved fascia on posterior border of scutellum; narrow fascia on posterior border of metanotum; broken fascia on dorsum of propodeum; lateral angles and spot on sides of propodeum; narrow line on metapleura; large spot almost divided into two on mesopleura; continuous fasciae on tergites 1–5, first deeply sinuate on anterior median margin, second inclosing almost completely a pair of dorsal black spots and emarginate on posterior median border, remainder bisinuate on anterior border and emarginate on posterior median border; obscure spots on tergite six; lateral spots on sternites 2–4; spot on coxae; femora in greater part; tibiae, except lines below and on posterior border; tarsi, except terminal segment of each; *white* with a slight tinge of *creamy yellow* in some places.

The flagellum is black and segment seven is bluntly but quite evidently spinose. Segments 9–11 are slightly excavated and segment 12 is flattened, distinctly curved, and roundly truncate at the apex, which is ferruginous in color. The intermediate femora are not considered serrate or dentate, although the apical end of the posterior border is slightly roughened. The middle tibiae and tarsi are normal. The anterior metatarsus bears six spines. The second sternite (on the type) bears an evident median carina that does not end in a process or spine. The second sternite of the male paratype bears a large, curved, sharply pointed process whose ventral surface is slightly concave. The seventh sternite is carinate on midline. The seventh tergite is deeply sinuate on either side apically, causing the tergite to end in a blunt point (fig. 118).

The *allotype* (female), though resembling the type closely, differs in maculations as follows: The labrum and clypeus are black, except narrow lateral borders; the scape is wholly black; spot at the insertion of antennae is much reduced; the scutum bears a broken U-shaped discal mark; the fascia on the propodeum is complete; the fascia on the second tergite (and probably that on the third, which is much retracted) bears a pair of completely inclosed discal spots; fascia



on fifth tergite is interrupted at midline; the spots on the sides of the thorax and propodeum are better developed; and the color in general is slightly more yellowish.

The wings on both sexes are hyaline and relatively long. The pubescence is short, white and sparse. The disk of the second sternite of the female is shining and bears numerous coarse punctures. On three of the female paratypes the fascia on the fifth tergite is continuous, and on two the scutum bears only the transverse posterior discal mark. On some the fascia on the third tergite incloses a pair of black discal marks.

Length 15 mm. Described from two males and five females from Africa. These specimens bear labels as follows: Type and allotype, "Neu-Kamerun, No. 153-67, Tessmann S. G."; male paratype, "Belg. Kongo, Duma, Ubanga-Dist., Dr. H. Schubotz leg., 20. X. 1910."; two females paratypes, the label, "Bosun, 545, 22.4.14, Tessmann."; another, the label, "Kamerun, Tsad-See, Garua, 21. VIII. 1909. Rigggenbach S. G."; and the fourth, the label, "Kamerun, Schafer S. G."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX OPINABILIS, new species**

Figures 149-152

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except small pair of black spots; space between antennae extending upward; pair of spots near anterior ocellus; scape below; anterior orbits shortened above; narrow posterior orbits; narrow posterior border of pronotum and side of prothorax, except large irregular black spot extending into tubercle; narrow lateral line on scutum above base of wings; narrow fascia on posterior border of scutellum; narrow fascia on metanotum; large posterior spot and narrow anterior vertical line on side of propodeum; spot on metapleura; long vertical spot on mesopleura; broad continuous fasciae on tergites 1-6, first narrowed medially, second inclosing pair of black spots, third almost completely inclosing pair of black spots, the others biemarginate on anterior border and all fasciae to a greater or less degree sinuate on posterior median border; lateral spots on sternites 2-6; femora, except spot at base below and line above on all; tibiae, save line above and below on all; and tarsi; *pale or light yellow*. The labrum, the lateral spots of thorax and propodeum, the lateral sternal spots, and the legs show a preponderance of yellow.

The flagellum is black above, light below, the ultimate segment becoming ferruginous at the apex. Segments 6, 7, and 8 are spinose below, but the spines are not conspicuous; segment 5 is prominent below but not spinose. Segments 9-11 are slightly excavated below

and segment twelve is curved, flattened toward the apex, which is bluntly rounded. The middle femur below near the apex is slightly roughened but can not be said to be dentate. The second sternite bears a median sharp-pointed process and the sixth a small wedge-shaped process whose apex does not extend to the apical border of the sternite. The seventh bears a median carina. The seventh tergite is coarsely punctuate and bears distinct lateral ridges but shows neither lateral angles nor lateral spines. It is sinuate laterally and is broadly rounded at the apex, which is slightly emarginate at midline.

*Allotype* (female).—Black: labrum; mandibles, except tips; clypeus, except pair of large black spots; pair of small spots on frons near vertex; broad anterior orbits shortened above; posterior orbits; sinuate fascia on posterior border of pronotum; side of prothorax, except irregular longitudinal spot which includes anterior part of tubercle; narrow lateral line above base of wings and broken transverse posterior discal mark on scutum; narrow fascia on posterior and lateral margins of scutellum; narrow fascia on metanotum; narrow curved fascia on propodeum, extended, enlarged, and interrupted on its posterior surface; spot on lateral angle and larger anterior spot on side of propodeum; spot on metapleura; large spot on mesopleura; continuous fasciae on tergites 1-5, first much narrowed medially, second inclosing pair of black spots and deeply emarginate at anterior midline, third inclosing pair of black spots, fourth and fifth biemarginate on anterior border and together with the second and third all strongly sinuate at posterior median border; lateral spots on sternites 2-5 extended inward but not forming continuous apical lines; femora in part; tibiae, except line above and below on all; and tarsi; *pale or soiled white*.

The flagellum is black above, ferruginous below, becoming much lighter in color toward the apex. The second sternite is shining and bears numerous coarse punctures scattered over the disk, and the sixth is coarsely punctate and distinctly carinate medially on its apical half. The sixth tergite is slightly sinuate laterally and much narrowed toward the apex, which is roundly pointed.

The wings of this species are hyaline and the second abscissa of both radiella and cubitella is present. The pubescence on head, thorax, propodeum, and base of abdomen is long, dense, and whitish in color. The frons between the antennae and the base of the clypeus are distinctly carinate. Of the female paratypes, two differ from the allotype in having a pair of narrow discal lines in addition to the broken transverse line on the scutum; while a third differs in having no discal mark on the scutum and in having the fascia on

the scutellum and the fascia on the first tergite interrupted at the midline.

Length 15–17 mm. Described from four males and four females. The type, allotype and three male paratypes bear a common label: "D. O. Afrika, Kagera, Haobert S. G." Of the female paratypes each bears a different label: "Chinchoxo, Falkenstein S"; "D. O. Afrika Kiwugebiet, Dr. Kandt S"; and "D. O. Afrika, 50 km. ostl. v. Kosongo Urwald Grauer."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX MAGDALENA C. L. Fox**

FIGURES 127, 128

*Bembix magdalena* C. L. Fox, Proc. Cal. Acad. Sci., vol. 15, 1926, p. 220.

This is an unusually well-marked species. The labrum is abnormally long and the maxillae are longer than the labrum, extending backward well beyond the coxae of the anterior legs. In this elongation of the maxillae this species resembles those belonging to the genus *Steniolia*. The ocelli are not entirely obliterated. At the base the seventh tergite bears prominent lateral angles that are produced into short, blunt spines, and the apical portion of the tergite is strongly rugose. The first cubital cross vein is almost straight. The sixth sternite bears a broad median process whose posterior end terminates in two blunt prominences with a slight depression between them.

Fox describes this species from males taken at Magdalena Bay, Lower California, May 30, 1925, by H. H. Keifer.

**BEMBIX BIDENTATA Van der Linden**

*Bembex bidentata* VAN DER LINDEN, Nouv. Mem. Acad. Sci. Bruxelles, vol. 5, 1829, p. 11.—HANDLIERSCH, Sitz. Akad. Wissensch, Wien, Math.-Nat. Cl., vol. 102, 1893, p. 773.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 502.

The male of this species is well marked. The last three segments of the antenna are excavated below; the anterior metatarsus bears seven spines; the posterior border of the middle femur is compressed to a thin edge whose apical half is dentate; the second and sixth sternites are without tubercles; and the seventh tergite is without lateral ridges but is provided at the base with prominent lateral spines. The propodeum and the metathorax are black and the mesothorax is almost wholly black. The fascia on the first tergite is widely interrupted; those on 2–4 are continuous; that on tergite 5, continuous or broken into three spots. The sixth bears a single central maculation and the apex of the seventh is maculated.

I have at hand two males identified by Mercet and bearing the label, "Los Molinos [Spain], G. Mercet." This species is widely distributed throughout the Mediterranean region.

**BEMBIX TENUIFASCIATA, new species**

Figures 204-206

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except pair of large basal spots; scape below: spot between antennae; very short, broad anterior orbits; posterior orbits, very broad below, narrowed to a point and not reaching vertex above; posterior border of pronotum; side of prothorax and posterior half of tubercle; curved fascia on posterior part of scutellum continued forward laterally on scutum at base of wings, and narrowed and interrupted on midline; narrow interrupted fascia on metanotum; curved fascia on propodeum, broadest on posterior surface; lateral angle and almost the whole side of the propodeum; large spot on metapleura; large triangular spot on mesopleura; narrow interrupted fasciae on tergites 1-6, the first more widely interrupted than the others, all of which are bisinuate dorsally on the anterior margin, and second, third, and fourth are slightly sinuate laterally on posterior margin; continuous fasciae on posterior border of sternites 2-5; minute lateral spots on sternite 6; legs, except black lines on all femora and tibiae, and the black terminal segment on all tarsi; *yellow*.

The flagellum is black. The tenth, eleventh, and twelfth segments are excavated below but none are spinose. The middle femora are plain. The apical segment of each tarsus is black and the other segments of the tarsi show a greater or less degree of dark color below. The second sternite is plain and the sixth shows a moderate transverse swelling or elevation not sufficiently prominent to be called a process or tubercle. The seventh tergite at its base bears lateral spines similar to those borne by *bidentata*.

The *allotype* (female) in color and the character of the maculations is almost exactly like the type. It differs in that the pair of small lateral spots on the scutum at the base of the wings are more prominent; the fasciae on tergites 2 and 4 are continuous and the one on the fifth tergite is more widely interrupted than the one on the first; and the tarsi do not show the black markings seen on the type.

The wings in this species are slightly and uniformly infumated. The pubescence is short and relatively sparse. The anterior metatarsus is provided with seven spines. The disk of the second sternite of the female is smooth and shining and bears numerous coarse punctures, and the sixth is carinate on midline.

Length 16 mm. Described from two specimens, one male and one female, each of which bears the label, "W. Afrika, Lagos, Coll. Bingham."

*Type*.—In the Zoologisches Museum der Universität, Berlin.

**BEMBIX MOBII Handlirsch**

*Bembex mobii* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 775.—DALLA TORRE, Cat. Hyml., vol. 8, 1897, p. 508.

I have before me a single male that I have doubtfully referred to this species. With regard to the structural characters of the antenna, the middle femur, the seventh tergite, the second and sixth sternites, the wings, and the genitalia, it agrees quite well with Handlirsch's description of *mobii*, but with respect to the maculations it shows considerable difference. The flagellum is ferruginous, darker above than below, and very dark, though hardly black, at the apex; the scutum, scutellum, metanotum, propodeum, metapleura, and mesopleura (except a minute spot below the wings) are entirely black; the fascia on the first tergite is greatly narrowed and widely interrupted, those on tergites 2 and 3 are much broader and are narrowly interrupted at midline, while those on 4 and 5 are still broader and are continuous; the lateral spots on sternites 2-5 are large and are united by apical lines; and sternite 6 is ferruginous and bears a pair of small yellow lateral spots. In the absence of any significant structural differences between this form and the male of *mobii*, I have chosen to consider it simply a variant of that species, though further collection and study of material may show that it belongs to a different species. The specimen bears the label, "Bosum. 22-4-14. Tessmann."

**BEMBIX STENEBDOMA Parker**

*Bembex stenebdoma* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 79 (Key).  
*Bembex stenobdoma* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 94 (description of species).

The spelling of the specific name with an "o" in the text instead of an "e," as in the key and in the explanation of the figures illustrating the species, is simply a typographical error. The specific name is derived from two Greek words meaning "narrow" and "seventh," descriptive of the character of the seventh sternite, and the spelling *stenebdoma* is the correct one. The seventh tergite bears distinct lateral emarginations, thus giving rise to distinct roundly pointed lateral angles. This feature was omitted from the original description.

The species is known only from the type (a male) in the collection of the Academy of Natural Sciences of Philadelphia. It was taken at Florence, Ariz.

**BEMBIX MEDITERRANEA** Handlirsch

*Bembex mediterranea* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 807.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 507.

For a discussion of the synonymy of this species the reader is referred to Handlirsch's treatment of the species. He proposed this name for the species because he could not determine to his own satisfaction to which, if any, of the previously described species (listed in his synonymy) the specimens before him belonged. When the identity of this species with that of a previously described species has been positively established (as in time it may be), this specific name will have to be set aside, but until that identity has been established it would only add to the confusion to refer to the species under any other name than the one given to it by Handlirsch.

There are in the United States National Museum a male from Italy and two males and three females bearing the label "Austria," all of which I have referred to this species. As represented by these specimens, the species is characterized by its pale, milky, yellowish color and by the unusually long pubescence on the propodeum. The tergites on the male, with the exception of a pair of small black discal spots on the second, are entirely pale yellow. The tergites on the female show a posterior black border. The middle femora of the male are dentate; the second and sixth sternites are without distinct processes, and the seventh tergite at the base bears distinct lateral angles.

**BEMBIX TOROSA**, new species

Figures 210-214

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except pair of basal spots; anterior orbits; lower part of frons; triangular spot below anterior ocellus; scape below; posterior border of pronotum including the greater part of the tubercles; almost the entire side of prothorax; lateral lines on scutum; curved fascia on scutellum; metanotum; broad curved fascia on dorsum and posterior surface of propodeum; metapleura; large irregular spot on mesopleura; prominent continuous fasciae on tergites 1-6, those on tergites 2 and 3 inclosing pair of elliptical black spots and those on 1-5 more or less emarginate at mid-dorsal line on posterior border; apex of seventh; lateral spots on sternites 1-6; legs, except line above on femora, line below on all tibiae, apical black spots below on all segments of the tarsi (reduced on hind pair), and conspicuous black apical spot above on the ultimate segment of all tarsi; *yellowish white*.

The flagellum is black and segments 9-11 are excavated below, but none of the segments are spinose. The apical segment, which exceeds

in length the segment immediately preceding, is somewhat curved and is roundly and obliquely truncate at the apex. The apical half of the lower border of the middle femur is distinctly dentate. The second and sixth sternites are plain and the seventh bears a distinct median, longitudinal carina, which is bordered basally on either side by a short carina. The seventh tergite is deeply sinuate on either side, forming prominent lateral angles that are bluntly spinose and the short median portion is slightly but plainly emarginate at the apex. The spine of the eighth sternite seen from below shows lateral swellings near its middle part (fig. 211).

The maculations on the *allotype* (female) are quite similar in character to those of the type, but their color is yellow instead of white. In addition to the lateral lines, the scutum bears a broken U-shaped discal mark composed of narrow lines. The maculations on the side of the thorax and propodeum are somewhat better developed than on the type. The fasciae on the tergites are all continuous and the second and third inclose black spots. Those on tergites four and five are of similar pattern but whether the black spots are completely inclosed can not be determined, owing to the retracted condition of the segments. The spot on the apex of the terminal tergite is less extensive than on the type. The apical spots on the under side of the segments of the tarsi are not so prominent as on the type, particularly on the hinder pair, and the apical black spot above on the terminal segment of all tarsi, although present, is not so intense as on the type. The flagellum is black. No part of the disk of the second sternite is wholly free from punctures, but those on the central part are coarser and more widely separated than those on the sides or those near the basal and apical median borders.

Variation in the maculations of the paratypes is not great. One female has the sixth tergite black, the fascia on the first tergite interrupted, and that on the fifth broken into spots. On the male paratype from New Britain the fasciae on tergites 2-5 inclose each a pair of black spots and no doubt this may be true for some of the other specimens but the retraction of the segments conceals the evidence.

The wings are only slightly infumated, those of the female being almost hyaline. The anterior metatarsus bears five spines. The pubescence is short, gray, and inconspicuous. The second abscissa of both radiella and cubitella is present. This species seems closely related to Handlirsch's species *pugillatrix* and *papua*.

Length 18 mm. Described from four males and five females. Of these, three males and four females (including type and allotype) bear a common label, "Neu-Guinea, Ramu-Expedit." The fourth

male bears the label "Neu-Britannien Ralum. E. Dahl S." The fifth female bears the label "D. N. Guinea, But, 11. 1910, H. Schaeede S. G."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

BEMBIX QUINQUESPINOSA, new species

Figures 162-164

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except pair of large basal black spots; broad anterior orbits narrowed and shortened above; lower part of frons connected with a spot below anterior ocellus and inclosing a median black spot above insertion of antennae; scape below; posterior orbits broad below, obsolete above; narrow fascia on posterior border of pronotum; tubercle except black spot in center; side of prothorax almost wholly; short lateral line on scutum above base of wings; small narrow lateral spots on scutellum; narrow widely interrupted fascia on metanotum; broad curved fascia on dorsum of propodeum extended downward on its posterior surface to end in two points; posterior lateral angles of propodeum; broad vertical anterior stripe on side of propodeum; two spots on metapleura; anterior border of mesopleura extended backward and then at a right angle upward in a narrow line to base of wing; also rounded posterior spot near base of wings and narrow line above base of middle leg on mesopleura; broad anterior fasciae on tergites 1-6; that on first tergite with irregular borders and narrowed at middorsal line; that on second irregular on posterior border and inclosing a pair of long, narrow, elliptical discal spots; that on third tergite similar to the one on the second but with the discal spots not fully inclosed; those on fourth and fifth tergites widely biemarginate on anterior border and somewhat irregular on posterior border; that on sixth tergite narrower than the others and interrupted at middorsal line; lateral spots on sternites 2-5 decreasing in size from two to five; coxae and trochanters more or less; line above and below on femora; tibiae above, except short line on anterior and middle pairs; tarsi, except spot below on each segment of anterior pair and short basal line below on posterior pair; *white*. The tarsi are somewhat tawny and the apical segment of each above is more or less dusky, the posterior ones being almost black.

The pubescence is short, white, and inconspicuous. The wings are very slightly and uniformly infumated. The frons between the antennae is carinate and strongly elevated and this elevation is continued on the base of the clypeus, causing the clypeus on either side at its base to appear strongly depressed. Segments 6 and 7 of the flagellum bear small pits below; 8 and 9 are distinctly spinose;



10 and 11 are deeply excavated; and segment 12, which is longer than the preceding segment, is strongly curved, squarely truncate at the apex, and its posterior apical angle forms an evident point. The anterior metatarsus is broad and bears five stout spines. The middle femur is plain. The second sternite is plain and the sixth has at its middle a low, rounded elevation that can not be classed as a tubercle or process. The seventh bears an evident median carina bordered on either side basally by a less evident carina. The seventh tergite bears a pair of evident, nonspinose, lateral angles and at its apex is strongly emarginate.

*Allotype* (female).—The allotype in color and maculations very closely resembles the type. The flagellum below is not so light, the metanotum is wholly black, the fasciae on the tergites are narrow and all, except that on the fourth tergite, are interrupted medially; that on the fifth is reduced to widely separated lateral spots. Lateral spots are borne only by sternites 2 and 3. The maculations on the legs are somewhat better developed than on the type and the tarsi show the same markings borne by the type.

The anterior metatarsus bears only five spines. The inner eye margins are only very slightly divergent at the clypeus. The lateral parts of the second sternite are closely covered with relatively fine punctures; toward the mid line the punctures are fewer and coarser; while on the mid line there is a narrow longitudinal area devoid of punctures. The abdomen shows a beautiful purplish iridescence.

Length, 21 mm. Described from a male and female collected by R. C. McGregor at Puerto Princessa, Palawan, P. I., September 15, 1925.

*Type* (male).—Cat. No. 40838, U.S.N.M.

#### BEMBIX PUGILLATRIX Handlirsch

*Bembex pugillatrix* HANDLIRSCH, Sitz. Akad. Wissensch, Wien, Math.-Nat. Cl., vol. 102, 1893, p. 780.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 511.

I have before me eight males and three females that I have referred to this species. The males, with respect to the antenna, the middle femur, the second and sixth sternites, the seventh tergite, and the genital stipites, agree with Handlirsch's description of the species. The maculations, however, can hardly be termed yellow; they are more nearly white with a faint yellowish or creamy tinge. While the different specimens show some variation in the extent of the maculations, this variation is no greater than that which Handlirsch points out in his description.

Of the three females that I have referred to this species the maculations are decidedly yellow, but on the tergites they are less extensively developed than on the males. On two of the females the

fasciae on the tergites are greatly narrowed and that on the first tergite is almost suppressed. Owing to this narrowing of the fasciae, the black discal spots in the fasciae are reduced to emarginations, of which those on tergites 2 and 3 are lost or are connected with the posterior black border of the tergite, while those on tergite 4 are connected with the anterior black border. One of these two females bears the label, "Nord-Celebes, Tali-Tali XI-XII, 95, H. Fruhstorfer V.," and the other the label, "Sula Mangoli, Oct.-Novbr., Doherty ex coll. H. Fruhstorfer."

Two of the males also show this suppression of the fasciae on the tergites but not to such an extent as the two females. One of these two males bears the label, "Niat, Bingham," and the other, the same as the first of the two females.

On the third female the fasciae are better developed and the discal black spots are inclosed. This specimen bears the label, "Davao, Mindanao, Baker," and two of the males also bear this same label. Three of the remaining males bear the label, "Insel Obi, Rolle V." The eighth male bears the label, "Culasi Panay, P. I., June, 1918, McGregor."

Handlirsch reports this species from Celebes, Luzon, Mindanao, Batjan, Halmahera, Amboina, and Neuginea.

**BEMBIX PERSIMILIS** Turner

Figures 156-158

*Bembex persimilis* TURNER, Mem. Dep't. Agr. Ind., Ent. Ser., vol. 5, 1917, p. 179.

Turner described this species from two males from Akalgarh, Punjab, India. I have before me a single male and seven females from Deesa, India. Turner does not mention the form of the eighth sternite of the male, which in this genus usually ends in a single-pointed spine. The eighth sternite of the male before me ends in a bifurcate or two-pointed spine. Below I am giving a detailed description of this species, based on the material before me. I am also giving figures of the prominent characters of the male.

*Male*.—Black: labrum; mandibles, except tips; clypeus; frons to the level of the anterior ocellar cicatrice, except a pair of broad black spots; scape almost wholly; posterior orbits, very broad below, not meeting across the vertex; prothorax except a pair of small anterior dorsal spots; broken U-shaped spot and broad lateral lines on scutum; narrow fascia on posterior border of scutellum, enlarged at the ends; narrow fascia on posterior border of metanotum; broad crescent-shaped fascia on dorsum of propodeum, extended on its posterior surface in a pair of points; lateral angles and sides of propodeum; metapleura and mesopleura; broad fasciae continuous on all tergites, first with a deep bilobed anterior median emargina-

tion, second, third, and fourth each with a pair of dorsal anterior emarginations; sternites 1-5; pair of broad longitudinal spots on sixth; the legs, except a black spot on each trochanter, black stripe on posterior side of intermediate and anterior femora, a black stripe on posterior side of anterior tibiae and four black spots on anterior metatarsus; *bright yellow*.

The flagellum is testaceous in color, darker above than below and lacks evident pits or spines. The apical segment is slightly curved and abruptly pointed at the apex. The anterior metatarsus is dilated and flattened and bears on its posterior border four black lobes. It also bears on its posterior border a comb composed of numerous thickly set, evenly developed dark spines. The intermediate tibia, at its anterior apical extremity, is drawn out into a spine-like process which bears a short spine. The intermediate femur is dentate and the metatarsus on its posterior border near the apex bears a comb of several short stout spines. The second sternite bears a prominent, laterally compressed median process and the sixth, a small, narrow, pointed tubercle. The eighth sternite ends in a flattened median spine that is distinctly bifurcate at the apex. The basal half of the clypeus on the mid line is slightly carinate and on either side is plainly depressed.

*Female*.—Black: labrum; mandibles, except tips; clypeus; frons to level of anterior ocellus, except a pair of black spots; broad posterior orbits not meeting above; prothorax; legs entirely; sides of metathorax, mesothorax, and propodeum; broad U-shaped mark and lateral lines on scutum; fascia on posterior border of scutellum, from the median point of which a narrow line runs forward; broad fascia on metanotum; broad curved fascia and lateral angles of propodeum; broad continuous fasciae on tergites 1-6, first with deep bilobed median anterior emargination, 2-5 each with a pair of dorsal anterior emarginations, and sixth with a pair of small widely separated anterior emarginations; sternites 1-5 wholly, except a median anterior black spot on 3-5; pair of lateral spots on sixth; *yellow*.

The scape of the antenna is entirely yellow. The first two segments of the flagellum are yellow below and dark above. The rest of the flagellum is testaceous, being lighter below than above.

The wings on both sexes are hyaline. The pubescence is short and sparse, that on the clypeus giving it a silvery sheen. The form of the clypeus in the female is the same as that on the male. There is some variation in the maculations on the several females. On all of them the basal half of the clypeus is of a brighter yellow than the apical half. On one specimen there is a pair of small black spots on the base of the clypeus. On a second the yellow is more extensive than on others; the posterior orbits are united at the vertex and the

emarginations on tergites one and two are reduced to paired black spots. In general the variations in the maculations are variations in extent rather than variations in pattern.

Length 14 mm. The specimens are all from Deesa, India.

**BEMBIX TENEBROSA, new species**

*Type* (male).—Black: clypeus; frons, except a pair of black spots above insertion of antennae and a third black spot above anterior ocellus; antennae; prothorax; tegula; lateral spots on scutum above tegulae; apex of tergites 5, 6, and 7; sixth sternite; femora except basal ends; tibiae; and tarsi, except apical segment; *dark ferruginous*. The flagellum is much lighter in color than is the scape. The base of the mandible and the labrum is soiled greenish yellow. The terminal segment of the anterior tarsus and the apex of the terminal segment of middle and posterior tarsi are black.

On the under side of the anterior tibia near the apical end is a rather large shallow depression on the proximal border of which is a prominent black spot and at the distal border of which there is a second black spot within which there is a conspicuous pit. On the under side of the anterior femur near the proximal end is a short but evident carina. The anterior metatarsus is provided with eight spines. The posterior border of the middle femur is compressed and wedgelike, especially near the base, but it is neither serrate nor dentate. The middle tibia is curved and the middle metatarsus on its inner side near the proximal end bears a small but evident protuberance. Segments 7, 8, and 9 of the flagellum are spinose, and 10, 11, and 12 are deeply excavated. The second sternite bears a well-developed, sharp-pointed, median process and the sixth a prominent, triangular, bluntly pointed process that extends slightly beyond the apical border of the sternite. The seventh sternite bears a pair of prominent, slightly divergent carinae that do not extend to the apical border of the sternite, which is broadly truncate at the apex. The seventh tergite is narrowed and roundly pointed at the apex. The eighth sternite ends in a long, slender spine that is curved downward near the middle at almost right angles to the axis of the segment.

The *allotype* (female) is quite similar to the type in the character of its maculations. The ferruginous color, however, is somewhat lighter in shade and the black on the clypeus, the black spots on the frons above the antennae, and the black on the apical segments of the tarsi are all lacking. A pair of obscure ferruginous lateral spots is found on each of the tergites 4 and 5 and the apex of 6 is also ferruginous. The sixth sternite is carinate medially and the disk of sternite 2 is smooth and shining and bears only a few scattered, coarsely punctures. The anterior metatarsus bears only seven spines.

The wings of the male are slightly and uniformly infumated while those of the female have the apical third clear and the basal two-thirds heavily infumated. On one of the two female paratypes the lateral spots on the tergites are lacking and on the other much reduced and on both the ferruginous on the terminal segment is much reduced.

Length 23 mm. Described from one male and three females bearing the label, "D. Ost-Afrika, Stuhlmann S."

*Type*.—In the Zoologisches Museum der Universitat.

#### BEMBIX DORIAE Magretti

*Bembex doriae* MAGRETTI, Ann. Mus. Genov., vol. 21, 1884, p. 590.—HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 891.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 504.

There is in the collection of the United States National Museum a single male of this species determined by Magretti. The basal half of the wings is heavily infumated, the apical part clear. The antenna, with the exception of the last three segments of the flagellum, is ferruginous, and segments 7-9 of the flagellum are spinulose beneath. The maculations of head, thorax, propodeum, and legs are ferruginous with a show of yellow on the labrum and mandibles, and on the tibiae and tarsi, especially on the hind pair. The clypeus shows a marked silvery pubescence. Maculations on the thorax are reduced to a narrow line on the pronotum, spot on side of prothorax, tubercles in part, and small lateral spots on scutum above base of wings. On the propodeum the only maculations are spots on the posterior lateral angles. The fasciae on tergites 1-5 are yellow and very broad. The first is abruptly narrowed and interrupted at the middorsal line; the second incloses a pair of narrow transverse discal spots; and the third, fourth, and fifth cover practically the entire surface of their respective tergites. The visible surface of tergites 6 and 7 are ferruginous. All sternites are ferruginous with 2-5 bearing small lateral yellow spots.

The middle metatarsus on its lower surface at the middle bears a prominent, longitudinally compressed, thin dilation. The second and sixth sternites bear prominent processes. The specimen was taken at Keren, Eritrea, February 27, 1900.

#### BEMBIX FUSCIPENNIS Lepeletier

*Bembex fuscipennis* LEPELETIER, Hist. Nat. Ins. Hym., vol. 3, 1845, p. 271.—HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 850.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 497.

The male of this species, with regard to structural characters, stands close to *doriae* Magretti. It differs from that species in having the fasciae on the tergites pale instead of yellow, and in

having the ferruginous limited to a central spot on sternite 2 and sternite 6, instead of having all the sternites ferruginous. The female resembles the female of *diversipennis*, but is much smaller and has a greater part of the frons black. The clypeus on the female before me is entirely ferruginous.

The female before me bears the label, "D. O. Afrika, Tabora, 7.08, Wintgens S. G." The single male at hand bears the label "Bulawayo, S. Rhodesia, 13-4-1924, R. H. R. Stevenson." Handlirsch reports this species from Cape of Good Hope, Port Natal, and Transvaal.

**BEMBIX STEVENSONI, new species**

Figures 196-200

*Type* (male).—Black: labrum; mandibles, except tips; sides of clypeus; posterior orbits; narrow line on posterior dorsal border of pronotum; narrow line on posterior margin of side of prothorax, including posterior margin of tubercle; small obscure spot at lateral angle on side of propodeum; large lateral spots on first tergite narrowed to a point toward middorsal line; continuous fasciae on tergites 2-5, that on second bearing a pair of long narrow dorsal spots not completely inclosed but continuous with the anterior black border, those on 3-5 bisinuate on anterior dorsal margin; lateral spots on sternites 2-5; femora in part; tibiae, except line below on all; and tarsi; *yellow*.

The greater part of clypeus; anterior orbits; transverse series of spots on frons below anterior ocellus; pair of spots above antennae connected with orbits; spot between insertions of antennae; scape; flagellum, except three apical segments; small lateral spot on scutum above base of wings; narrow obscure lateral spots on scutellum; apical border of fifth tergite; fascia on sixth; apical portion of seventh; large central area on second sternite; broad transverse band on sternites 3-5 extending between lateral yellow spots; almost the whole of sternite 6; *ferruginous*.

Segments 7-9 of the flagellum are slightly but plainly spinose and segments 10-12 are entirely black, while, with the exception of 9, which is black in part, the remaining segments of the flagellum and the scape are a light ferruginous color. The middle femora are smooth. The spur on the middle tibia is short, broad, and thumblike. The middle metatarsus bears on its inner (lower) surface a relatively large swelling or protuberance. The second sternite bears a prominently laterally compressed, pointed process, and the sixth a prominent, flattened process whose apical margin is broadly rounded. The seventh sternite is narrowed toward the apex, which is roundly truncated and on its ventral surface it bears a pair of

short prominent lateral carinae. The seventh tergite is deeply sinuate laterally, narrowed and truncated at the apex.

The *allotype* (female) differs but slightly from the type with respect to its maculations; the lateral spots on the scutellum are continued by narrow lines that almost meet at middorsal line; there is a broken line on the metanotum; there is a narrow fascia on the propodeum and the spot on its lateral angle is larger; the fasciae on the first tergite is continuous but narrowed dorsally; that on the second incloses a pair of black spots; the apex of the fifth tergite is ferruginous and the sixth is wholly so. The antenna is ferruginous, but the scape, the first segment of the flagellum and the base of the second are black above. The apex of the flagellum is darker than the rest of it, but the contrast is not so great as on the type. The sixth sternite is ferruginous and carinate on the midline. The disk of the second is smooth and bears on either side the midline numerous coarse punctures. The sixth tergite is triangular in outline, rounded at the apex and bears, except along its median part, numerous, short, stout spinelike hairs.

The wings in this species are lightly but uniformly infumated, the infumation being somewhat more pronounced in the female than in the male. The pubescence is of normal character. The clypeus is strongly arched and only slightly carinate at base. The frons between the antennae likewise is only weakly carinate. The anterior metatarsus is provided with six spines. On both type and allotype the ferruginous bands between the lateral yellow spots on the sternites inclose more or less black that may take the form of a narrow transverse line. Of the paratypes (females) two have the fascia on the first tergite interrupted and the base of the clypeus strongly bordered with black, and one of the two has both the metanotum and propodeum without maculations. On both, the fascia on the second tergite has a pair of deep anterior emarginations instead of the inclosed black spots found on the allotype. A third has the markings on the thorax and propodeum white. On this specimen the antennae are almost like those of the type in color.

The type of this species was received in an exchange and had been identified as *Bembea capensis* Lepeletier by R. H. R. Stevenson, for whom the species is named. The original description of *B. capensis* Lepeletier states that the antenna is black, whereas in this species the scape and the first eight segments of the flagellum are ferruginous. Furthermore, in this species neither the clypeus nor the labrum is marked at all with black and the process on the sixth sternite, instead of being small and subacute, is prominent, broad, and rounded at the apex. It is further distinguished from *capensis* by the infumated wings.

Length 14–17 mm. Described from one male and four females (including type and allotype). The type was collected by R. H. R. Stevenson at Bulawayo, South Rhodesia, and the allotype bears the label "D. O. Afrika, Tabora, 7. 08, Wintgens S. G." The paratypes bear a common label, "Victoria-Nyansa, I. Ukerewe, Conrads S. G."

*Type* (male).—Cat. No. 40839. U.S.N.M.

*Allotype and paratypes*.—In the Zoologisches Museum der Universität, Berlin.

**BEMBIX REFUSCATA, new species**

Figures 169–171

*Type* (male).—Black: labrum; clypeus; scape; frons, except two narrow vertical lines connected by a third line across the frons; broad anterior orbits; posterior orbits; *pale*, suffused in many places with ferruginous. Greater part of prothorax; tegulae; short line on scutum above tegula; legs, except basal segments; seventh tergite; apical border of sixth and to a slight extent that of the fifth; *ferruginous*. Lateral angles of propodeum; widely interrupted fasciae on tergites 1–5; *yellow*.

The flagella are missing and the tarsi are broken on all legs except one of the posterior pair. The anterior femur below bears a broad pale stripe separating the black at the proximal end and extending almost to the apex of the segment; and each anterior coxa bears a large, pale spot. The middle femur is smooth; the middle tibia is slightly curved; and the middle metatarsus, on its inner side, near the proximal end, bears a small but quite evident swelling or protuberance. The apex of the terminal segment of the posterior tarsus is black. The second sternite bears a small sharp-pointed process and the sixth a prominent bluntly pointed process, whose apex extends beyond the apical border of the sternite and whose sides are ferruginous in color. The seventh bears a pair of prominent lateral basal carinae. The seventh tergite is triangular in outline, truncate at apex, and slightly carinate on dorsal midline.

The *allotype* (female) very closely resembles the type in color and the character of the maculations. It differs in that only the labrum and clypeus are pale; that the frons, except for an area above the anterior ocellus, is wholly ferruginous; that the lateral angles of the propodeum are not maculated; and that the maculations of tergites 1–5 are pale with a tinge of ferruginous instead of yellow. The flagella are very light ferruginous. The sixth tergite is darkly ferruginous, slightly sinuate on the sides, broadly rounded at the apex, and covered almost to the apex with short, stout, spine-like hairs. The disk of second sternite is shining and bears numerous punctures.



The wings of this species are slightly infumated. The inner eye-margins are somewhat divergent at the clypeus. The frons between the antennae is strongly carinate and the carina is continued on the basal part of the clypeus. The pubescence is short and inconspicuous. The lateral margins of the propodeum are similar to those of *recurva*.

I have assigned to this species a male bearing the label "Victoria-Nyansa, I. Ukerewe. Conrads S. G." The genitalia of this specimen had been removed before the insect reached me. Segments 8 and 9 of the flagellum are spinose, and 10, 11, and 12 are excavated below. The eleventh is broad and the twelfth is narrowed toward the apex and somewhat curved. In other structural characters this specimen agrees with the type and it also agrees in having the pale line below on the anterior femur and the pale spots on anterior coxae. It differs in that the maculations on the tergites are pale instead of yellow; that the fascia on tergite 3 is continuous and those on 2, 4, and 5 are only narrowly interrupted; and that 2 incloses a pair of black spots.

Length 22 mm. Described from three specimens from eastern Africa. The type bears the label, "D. O. Afrika, Kamoga, Fr. Müller S." Allotype bears the label, "D. O. Afrika Mkatta I-VI '09, Schönheit S. G."

*Type*.—In the Zoologisches Museum der Universität, Berlin.

#### BEMBIX INSULARIS (Dahlbom)

*Monedula insularis* DAHLBOM, Hym. Eur., vol. 1, 1845, p. 186.—CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 143.

*Bembex insularis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 826.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 506.

Dahlbom's description of *Monedula insularis* is not complete enough or detailed enough to enable one to determine just what species he had before him, but Handlirsch, in his description of this species, states that he had, among the specimens he examined, two of Dahlbom's types. That being the case, there can be no doubt of the identity of the species. Cresson's description was beyond doubt based upon a species of *Bembex*, and a comparison of his description with that given by Handlirsch convinces me that the two authors were dealing with one and the same species.

In the collection of the United States National Museum are two males from Jamaica that I have referred to this species. On these males the sixth sternite, in addition to the median process, bears a pair of evident lateral processes, a character that neither Handlirsch nor Cresson mentions. This character is present also on the males of *infumata* Handlirsch, *nubilipennis* Cresson, and *hamata* C. L. Fox.

Handlirsch's specimens and likewise Cresson's came from Cuba, while Dahlbom's were from the Islands of St. Thomas and St. Bartholomew. I have also before me a male and female of this species taken by C. C. Gowley on the island of Jamaica.

**BEMBIX SINUATA** Latreille

*Bembex sinuata* LATREILLE, Gen. Crust. and Ins., vol. 4, 1809, p. 98.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 744.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 514.

The male of this species, although resembling the male of *bidentata* in general appearance, is well marked and distinct. The seventh tergite lacks the lateral spines found on *bidentata* and is broadly and bluntly rounded. The seventh segment of the flagellum is strongly and transversely excavated below, and segments 9-12 are also excavated but not transversely. The clypeus is strongly prominent and flattened on the ventral part, forming a V-shaped ventral area. The anterior metatarsus bears seven spines and a prominent median carina below. The posterior border of the middle femur is flattened, somewhat curved, and distinctly dentate. The spur on the middle tibia is dilated, spoon-shaped. The second sternite is tuberculate, the sixth plain, and the seventh bears a prominent, blunt tubercle whose ventral border is flattened.

The female is characterized by the many spinelike hairs on the sixth tergite. These are also present on the apical border of the fifth. The clypeus bears a median black spot. The fasciae on the tergites are continuous and the sixth tergite has the apical half maculated.

I have at hand two males and two females of this species determined by Mercet. The four specimens bear a common label, "Los Molinos [Spain] G. Mercet." The species seems to be limited in distribution to those regions bordering on the western part of the Mediterranean Sea.

**BEMBIX ARCUATA** Parker

Figures 217, 220

*Bembix arcuata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 81.

In this species the ocelli, though much distorted, are not completely obliterated; lenses are visible. The male, in common with the male of *U-scripta* Fox, has the scape much thickened, the labrum with a small hump on the midline, the anterior metatarsus with 10 spines, the middle tibia with the anterior apical border produced into a spinelike process, the middle metatarsus concave and beset with spines on the inner side, and the seventh tergite with apical lateral ridges and with distinct but not sharply defined basal lateral angles.

Both species have the middle femora dentate below, the second and sixth sternites without processes, and the seventh sternite with a pair of widely separated carinae that diverge basally. The male genitalia of this species differ widely from that of *U-scripta*. The two species also differ in the character of their maculations.

## SPECIMENS EXAMINED

KANSAS.

NEW MEXICO: Mesilla (June 26, 1897, Cockerell).

TEXAS: Cotulla (May 11, 1906, J. C. Crawford).

## BEMBIX U-SCRIPTA Fox

## Figure 218

*Bembex U-scripta* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 362.

*Bembix U-scripta* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 83.

In the collection of the United States National Museum there is a single specimen of this species, a male, bearing the designation "Type," but by whom so marked I do not know. It bears the label "Tucson, Arizona, Coll. Ashmead," and since Fox based his description of the species in part on material collected at Tucson by Ashmead it is quite probable that this is a male from the group on which Fox based his description. Fox also had some material from California, and I have identified specimens of this species from New Mexico. It is closely related to the preceding species (*Bembix arcuata* Parker), with which it agrees in its most prominent structural characters, as set forth in the discussion of that species.

## BEMBIX VELOX Handlirsch

*Bembex velox* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 819.

Handlirsch described this species from a single male from Zanzibar, Africa. I have before me one male and six females that I have, after considerable hesitation, referred to this species. With respect to the character of the antennae, the middle femora, the processes on the second and sixth sternites, and the genitalia, this male agrees with the description and figures given by Handlirsch for *Bembix velox*. It differs from the description of that species, however, in having the wings clear and in having a pair of minute black spots on the clypeus. The form of the seventh tergite differs slightly from that shown in Handlirsch's figure of the seventh tergite of *velox*. Since Handlirsch had but a single individual from which to write his description, the variations within the species were unknown to him, and it seems to me that the differences noted above are well within the limits of variation possible within a species.

The females in general form and appearance resemble very closely the male with which I have associated them. They differ

from the male in the following respects: The frons, except a small round spot on either side the anterior ocellus, is entirely black; the clypeus, except the ventral-lateral areas, is also black; and the labrum, except a narrow longitudinal, lateral stripe on either side, is likewise black. The fasciae on the tergites are similar to those on the male, except that the first fascia is continuous on some specimens and more or less widely interrupted on others, and the second fascia bears inclosed discal marks instead of anterior emarginations. On two of the females there is a pair of transverse discal marks on the extreme posterior border of the scutum; on all there are maculations on the posterior dorsal surface of the propodeum; and on some the metanotum is also maculated. The wings are only slightly infumated.

The male bears the label, "D. O. Afrika, Forst St. Msalla, 15. IV. Brandenburg S. V." The females bear a common label, "Victoria-Nyansa, I. Ukerewe, Conrads S. G."

#### BEMBIX CINEREA Handlirsch

*Bembix cinerea* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 102, 1893, p. 837.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 503.

*Bembix cinerea* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 84.

This species seems to occur only in those States bordering the eastern and southern coasts of the United States. The species is relatively small and is sparingly maculated. The male has the lateral areas of the clypeus black. The specimens on which Handlirsch based his description of the species were from Georgia.

#### SPECIMENS EXAMINED

FLORIDA.

GEORGIA.

NEW JERSEY: Cape May (July, 1890).

TEXAS.

#### BEMBIX HINEI Parker

*Bembix hinei* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 86.

This species is very closely related to *cinerea* Handlirsch, from which it may be distinguished by the fact that in this species the tarsi are invariably yellow, whereas in *cinerea* the tarsi are wholly or in part black, never wholly yellow. The mandibles on *cinerea* are black, whereas on this species they are largely yellow. On the male of this species the clypeus is wholly yellow and the genital stipes is quite different from that of *cinerea*. This species is larger than *cinerea* and its maculations are better developed.

#### SPECIMENS EXAMINED

LOUISIANA.

TEXAS: Brownsville; Galveston (May, F. H. Snow); Padre Island (June 29, 1895).

**BEMBIX ALACRIS, new species**

Figures 87-89

*Type* (male).—Black: mandibles, except tips; pair of small spots below anterior ocellus; narrow posterior orbits; narrow line on posterior border of pronotum uniting small lateral spots; spot on side of prothorax extending to posterior border of tubercle; lateral spot on scutum at base of wings; narrow fascia on posterior border of scutellum; narrow, broken fascia on metanotum; pair of spots on posterior surface of propodeum; lateral angle of propodeum; spot on side of propodeum; spot on metapleura; fascia on first tergite, narrowed and interrupted at dorsal midline; broad fascia on second, inclosing a pair of dorsal elliptical spots and narrowed at dorsal midline; broad fascia on tergites 3, 4, and 5, biemarginate on anterior border and sinuate at midline on posterior border; fascia on sixth tergite; lateral spots on sternites 2-5; femora in part; tibiae, except below on all; and tarsi, except lower surface of anterior pair: *yellow*.

The wings are hyaline; the antennae are black, the scape being very thick and heavy. Of the flagellum, segments 6, 7, 8, and to a slight extent 9, are spinose, and segments 9, 10, and 11 are excavated below. The ultimate segment is strongly curved, flattened and pointed at the apex, which is very light in color. The middle femora are dentate, the teeth, five in number, being limited to the apical half of the femur. The second sternite bears a well-developed median carina and the sixth, a conspicuous median swelling which can not be properly called a tubercle or process. The frons between the antennae is carinate and the eye-margins are approximately parallel. The anterior metatarsus is provided with six spines, which are white in color. The seventh tergite is abruptly narrowed toward the apex, which is roundly pointed (fig. 88). The seventh sternite is much narrowed at the apex and is not distinctly carinate.

This species stands close to *B. melanopa* Handlirsch, from which it may be distinguished by the different form of the seventh tergite, by the lack of a process on the sixth sternite, by the white spines on the anterior metatarsus, and the different form of the genital stipes.

Length 17 mm. Described from a single specimen bearing the label, "Somali, Salakle, 7-6-01, B. V. Exlauger."

*Type* (male).—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX ALDABRA, new species**

Figures 83, 84

*Type* (male).—Black: labrum; mandibles, except tips; clypeus; area between antennae; pair of spots on frons below anterior ocellus; scape below; broad anterior orbits deflected away from the eye-margins above and extended to the vertex; posterior orbits narrowed

above; narrow posterior border of pronotum; sides of prothorax, except large spot in front of tubercles; broad lateral lines and broken U-shaped discal mark on scutum; narrow fascia on posterior border of scutellum widened at its extremities; fascia on metanotum; narrow fascia on propodeum, widened and interrupted on its posterior surface; large spot on lateral angle and side of propodeum; spot on metapleura; narrow spot on mesopleura; fasciae on all tergites continuous; that on first tergite broad laterally, narrower dorsally and deeply notched at midline on anterior border; that on second tergite inclosing pair of dorsal black spots and also notched at midline on anterior border; remaining fasciae more or less deeply biemarginate on anterior border; small lateral spots on sternites 2-4; femora in part; tibiae, except spot below on all and spot above on anterior pair; and tarsi; *yellow*.

The flagellum is black above, testaceous below; the seventh segment is slightly spinose on its posterior median border and the eighth and ninth segments are very slightly spinose at the posterior apical border. Segments 9-11 are somewhat excavated below and the terminal segment is slightly curved and light in color at the apex. The frons between the antennae is carinate, as is also the base of the clypeus. The anterior metatarsus bears six spines. The inner margins of the eyes are approximately parallel. The middle femur on the distal half of its posterior border is dentate, the teeth being quite small. The second sternite is carinate on the midline, with the posterior end of the carina taking the form of a weakly developed tubercle. The sixth sternite bears a distinct tubercle that is not at all pointed. The seventh sternite bears a prominent, median, longitudinal carina, and the seventh tergite is distinctly, though not deeply, emarginate at the apex. The wings are hyaline and the pubescence normal.

With respect to the maculations, there is little variation between the type and the eight paratypes. With respect to the development of the processes on the second and sixth sternites, however, there is considerable variation, and in the preparation of my key to the males of this genus I have endeavored to avoid confusion due to this variation by inserting this species in the key in two places.

In the collection of the United States National Museum, taken by the same collector at the same place as the males assigned to this species, and presumably at the same time, is a single female that may be the female of this species, but in the character of its maculations it differs so widely from the males that, in the absence of any data other than that just stated above, I do not feel justified in assuming that it is the female of this species. The antennae are black; the frons, clypeus, and labrum are almost wholly black, and maculations on the scutum, scutellum, and propodeum (except on the lateral angles) are entirely lacking.

Length 15 mm. Described from nine males (including the type) that bear a common label, "Aldabra I., Indian O., W. L. Abbott."

*Type*.—Cat. No. 40840, U. S. N. M.

**BEMBIX TREPANDA** Dahlbom

Figures 207-209

*Bembex trepanda* DAHLBOM. Hym. Eur., vol. 1, 1845, p. 181.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 736.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 515.

The male of this species is characterized by the almost angular dilation of the posterior border of the anterior femur, by the serrate middle femur, and by the lateral lobes and apical emargination of the seventh tergite. Segments 7 and 8 of the flagellum are distinctly spinose, segments 9-11 are dilated and excavated below, and segment 12 is strongly curved. The genitalia are shown in Figure 209. In both sexes the anterior metatarsus bears seven spines, and the second abscissa of the cubitella is lacking. The wings of the female are relatively shorter than is normal in this genus.

The specimens of this species in the United States National Museum are all from Deesa, India. Handlirsch reports this species from Mauritius and Ceylon; Cameron reports it from Barrackpore, Bombay, and Gilgit.

**BEMBIX ORIENTALIS** Handlirsch

Figures 153-155

*Bembex orientalis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat., Cl., vol. 102, 1893, p. 737.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 510.

This species stands very close to *Bembix trepanda*, from which species the male may be distinguished by the absence of an apical emargination on the seventh tergite, by the fact that segments 7 and 8 of the flagellum are not distinctly spinose below, and by the different form of the genital stipes. The female differs from the female of *trepanda* by having the sixth tergite black. A single female in the United States National Museum, received in an exchange as a female of this species, bears a pair of basal black spots on the clypeus. It bears the label, "Sikhim, Coll. Bingham." The two males that I have referred to this species are from Deesa, India.

**BEMBIX SECULATA**, new species

Figures 190-192

*Type* (male).—Black: labrum; mandibles, except tips; clypeus; broad anterior orbits deflected inward on vertex to join broad posterior orbits; frons below anterior ocellus, save pair of widely sep-

arated black spots; scape, save black spot apically above; prothorax; prominent U-shaped discal mark and broad lateral lines on scutum; broad fascia on scutellum with short anterior extension at midline; metanotum; propodeum almost entirely; metapleura; mesopleura, except a minute round spot; broad continuous fasciae on tergites 1-6, first, second, and third each bearing a pair of dorsal spots, fourth and fifth biemarginate on anterior border; sternites 1 and 2; sternite 3, except small median anterior spot; fasciae on 4 and 5 each with a prominent median and pair of smaller lateral anterior emarginations; narrow interrupted apical fascia on sternite 6; legs, except posterior line on all femora; *yellow*.

The flagellum is testaceous below, darker above, and segments 6, 7, and 8 are spinose on posterior border. The apical segment is strongly curved and sharply pointed, giving the segment a sickle-shaped outline. The intermediate femora are serrato-dentate. The second sternite bears an evident median carina and the sixth bears a slight median process, which terminates near the apex of the segment and from which a transverse ridge extends on either side to the margin of the sternite at a short distance from the apex. The apical part of the seventh sternite bears a median carina and is pointed at the apex. The seventh tergite bears distinct lateral lobes (fig. 191), in this respect resembling *trepanda* and *orientalis*.

*Allotype*.—Black: labrum; mandibles, except tips; clypeus, except a pair of small basal black spots; anterior orbits deflected inward at the vertex to join the posterior orbits; frons below anterior ocellus, except a pair of large black spots; prothorax; broad U-shaped mark and broad lateral lines on scutum; very broad fascia on scutellum with short median anterior prolongation; metanotum; propodeum almost entirely; metapleura; mesopleura; broad fasciae on tergites 1-5, each emarginate at midline posteriorly, first, second, and third each inclosing a pair of dorsal spots, fourth and fifth biemarginate on anterior border; sternite 2, except large median spot; fascia on sternite 3 with deep anterior median emargination; fascia on 4 with large median and pair of smaller lateral emarginations; fascia on 5 reduced almost to lateral spots; minute lateral spots on 6; legs, except black line on posterior surface of all femora and trace of black on posterior surface of hind tibiae; *yellow or yellowish white*.

The pubescence is short, white, and normal in development. On the clypeus of the female it imparts a silvery sheen. The flagellum of the female is darker than that of the male, its apical segment is curved slightly but is not so sharply pointed as is that of the male. The wings are hyaline. Basally the clypeus is carinate on midline and somewhat depressed on either side. On all specimens there is a pair of small black spots on the mesosternum.



Length 15 mm. Described from three males and two females from Deesa, India.

*Type, allotype, and paratypes.*—Cat. No. 40841, U.S.N.M.

**BEMBIX BELFRAGEI** Cresson

*Bembex belfragei* CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1873, p. 220.

*Bembex cressonis* HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 793.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 503.

*Bembex insignis* HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 793.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 506.

*Bembix belfragei* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 92.

The reasons for the synonymy given above were set forth in my previous paper on the Bembicine wasps and need not be repeated here. This species is well marked and is not likely to be confused with any other species thus far described from North America.

SPECIMENS EXAMINED

TEXAS: Cotulla (May 5, 1905, W. D. Pierce).

WISCONSIN: North Hudson, St. Croix County (July 7-12, 1910).

This species has been reported also from Georgia, Kansas, and Louisiana.

**BEMBIX RUGOSA** Parker

Figures 215, 216

*Bembix rugosa* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 95.

This species, which is known only from the type (a female) in the United States National Museum, may be readily recognized by its unusually long, narrow labrum and its rugose sixth tergite. When this species was described I raised the question of the possibility that this may be the female of *Bembix stenebdoma* Parker, not so much because of the resemblance of the two sexes as because of the resemblance of the male and female, respectively, to the male and female of *Bembix belfragei* Cresson. But until more evidence is available I do not think it proper to associate the two as sexes of one species. The type bears simply the label "Ariz."

**BEMBIX INTEGR** Panzer

*Bembex integra* PANZER, Faun. Ins. Germ., vol. 8, 1805, p. 84.—HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 701.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 506.

The male of this species, with respect to the dilation of segments 2-4 of the anterior tarsus and of the middle metatarsus, resembles *zonata*, but on this species the dilation of the anterior tarsus is marked with black, which is not the case on *zonata*. The middle femur on this species has the posterior border distinctly curved and strongly dentate, whereas on *zonata* it is straight and not dentate.

In addition the process on the sixth sternite is strongly developed into a median tubercle on this species and the maculations on the sternites consist of only lateral spots.

The female may be distinguished from *zonata* by the presence of only lateral spots on the sternites instead of broad fasciae, and by the lack of conspicuous maculations on the thorax and propodeum.

This species is distributed over central and southern Europe. I have before me three males and seven females, of which one male and two females were determined by Mercet. This male bears the label, "Granja, G. Mercet," and the two females bear the label, "Los Molinos [Spain], G. Mercet." One of the other males is labeled "Germany," and the second is labeled "Austria." Of the five remaining females, three bear the label, "Austria"; a fourth, the label, "Valley of Ordena, Pyrenees (Seitz) 1400-1700 m.,"; and the fifth is without a locality label.

#### BEMBIX AMOENA Handlirsch

*Bembix amoena* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 769.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 502.

*Bembix amoena* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 88.

This species is very closely related to *B. sayi* Cresson. With respect to the males, the only character upon which I can rely to separate the two species is the length of the apical spur on the middle tibia, which on *amoena* is always relatively longer than on *sayi*. Although there is some variation in the length of this spur on each species, it is, in the case of *amoena*, approximately equal to or greater than half the length of the middle metatarsus, whereas on *sayi* it is always less, and usually very much less, than half the length of the middle metatarsus. This difference in length of the tibial spur of the middle leg holds for the females of the two species also, but the difference in the maculations of the dorsum of the thorax and propodeum of the females of the two species is more constant and therefore more reliable than are any differences in maculations on the males.

#### SPECIMENS EXAMINED

CALIFORNIA: Yosemite (July 20, 1905, J. McFarland).

NORTH DAKOTA: (C. N. Ainslie).

UTAH: Beaver Creek Hills, Beaver County; Silver Lake (July 14, H. Skinner).

WASHINGTON: Govan (August 6, 1911, Hyslop); Medical Lake (July 15, 1920, M. C. Lane); Soap Lake, Grand Coulee (June 29, 1902).

WYOMING: Butte (August 27, 1896, R. P. Currie); Yellowstone Park (July 17, 1907, W. Robinson; August 4, H. Skinner).

Handlirsch reports this species also from Colorado, Illinois, Nevada, and British Columbia.

## BEMBIX SAYI Cresson

*Bembex sayi* CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 467.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 877.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 513.

*Bembix sayi* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 90.

Cresson based his description of this species upon two females from Colorado, which differed from one another in size and also to some extent in their maculation. He says that on one specimen there were obscure dusky areas on the anterior apical corners of the clypeus, but he failed to state on which of the two specimens these dusky areas occurred. On both of these specimens the sixth tergite was entirely black. Handlirsch based his description of this species on a single female from Illinois and this specimen had the sixth tergite maculated. Fox described a male from Illinois that he considered the male of this species. It was this male that I made the type of *Bembix foavi* Parker, whose description appeared in my preceding paper on this group.<sup>6</sup> In the collection of the United States National Museum are females from Colorado that answer perfectly to Cresson's description of the larger of his two specimens upon which the species was based, and in the collection are also males from Colorado that so closely resemble these females as to warrant the assumption that they are males of this species. On all these specimens, both males and females, the fasciae on the tergites are very light, almost white. In the collection, with the sixth tergite conspicuously maculated, are other females that I have referred to this species, some of which are similar in color to those light forms mentioned above and some are of rich golden yellow. It is possible that I am including here specimens of more than one species, but the limited material at hand and the absence of males to associate with these extensively maculated females does not permit a splitting of this group into distinct species.

## SPECIMENS EXAMINED

COLORADO: Alamoza (August 6, 1903, Dyar and Caudell); Boulder (August 5, 1908, S. A. Rohwer); Cope (August 9, 1905, S. A. Johnson); Golden.

FLORIDA: St. Augustine (Cockerell).

KANSAS: (SNOW).

NEW MEXICO: High Rolls (June 14, 1902).

TEXAS: Aguilares (April 21, 1906, J. D. Mitchell).

## BEMBIX FUMIDA, new species

Figures 102, 103

*Type* (male).—Black: labrum; clypeus, except a bilobed basal spot; scape below; mere traces of posterior orbits; lines on femora,

<sup>6</sup> Proc. U. S. Nat. Mus., vol. 52, 1917, p. 96.

tibiae, and tarsi of first pair of legs; spot at end of femur of second and third pairs of legs; *pale or soiled yellow*. Aside from these few maculations the body of the insect is a uniform smoky black in color. The tarsi are not so black as the body proper.

The inner eye-margins are parallel. The flagellum of one antenna and the last three segments of the other are missing. Segments 7-9 of the remaining imperfect antenna are spinulose. The middle femur is dentate. The second sternite bears a small, compressed, pointed process, and sternite 6, a prominent, low, broad process whose posterior, free border approaches a semicircle in outline; there is also on sternite 6 a pair of small lateral processes on the extreme posterior lateral angles of the sternite. The seventh tergite is abruptly narrowed toward the apex, which is roundly truncate (fig. 103). The wings are slightly infumated, the infumation being heavier at the middle of the wing than at the apex. The second abscissa of both the radiella and the cubitella is present. The pubescence is short, dense, and gray in character.

Length 15 mm. Described from a single male from Japan.

*Type*.—In the Zoologisches Museum der Universität, Berlin.

#### BEMBIX OCULATA Latreille

*Bembix oculata* LATREILLE. Hist. Nat. Crust. and Ins., vol. 13, 1805, p. 302.—HANDLIRSCH. Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 102, 1893, p. 854.—DALLA TORRE. Cat. Hym., vol. 8, 1897, p. 509.

According to Handlirsch, this is a widely distributed and an exceedingly variable species and because of this great variation, due to the extent and the color of the maculations and to the presence or absence of infumation in the wings, he recognized eight different forms under which this species occurs. All the specimens before me belong to what he termed the Southwest-European form.

I have before me four males and five females, of which two females and two males have been determined by Mercet. Of these four the two males and the one female bear the label, "Madrid, G. Mercet," and the second female, the label, "Los Molinos, G. Mercet." Of the remainder one male and one female bear the label, "J. Lichtenstein, Montpellier, France"; one female bears the label, "Sardinia, A. H. Krausse"; and the other male and female are without locality labels.

#### BEMBIX NIGROCORNUTA, new species

Figures 141-144

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except a narrow basal border; a transverse row of spots on frons below level of anterior ocellus; narrow posterior orbits; prothorax,

except spot in front of tubercle; U-shaped discal mark and lateral lines on scutum; fascia on posterior border of scutellum; narrow fascia on posterior border of metanotum; curved fascia on dorsum of propodeum; lateral angles of same; large triangular spot on mesopleura; spot on metapleura; fasciae on tergites 1-5 all continuous except the fifth; first and second each inclosing a pair of dorsal black spots; third and fourth each having a pair of anterior emarginations; lateral spots on sternites 1-5; pair of conspicuous spots on anterior coxae; femora, save a stripe above and a spot below on each; tibiae, save for a narrow stripe below on each; and tarsi; *bright yellow*.

The antenna is entirely black. Segments 6 and 7 of the flagellum are slightly spinose on posterior border; 10 and 11 are excavated and when seen from above are decidedly broader than the apical segment, which is curved and roundly truncate at the apex. The intermediate femora are dentate. The second sternite bears a small, median, sharp-pointed process. The sixth bears a flattened, broadly triangular, bluntly pointed median process and a pair of small, pointed lateral processes. The seventh sternite is narrowed posteriorly and is squarely truncate at the apex. The seventh tergite is coarsely punctate and its posterior border is slightly notched or sinuate on either side the midline.

*Allotype*.—Black: labrum; mandibles, except tips; apical half of the clypeus divided by a median dark line; spots below anterior ocellus; posterior orbits; prothorax; U-shaped mark and lateral lines on scutum; fascia on posterior border of scutellum enlarged at the ends; fascia on posterior border of metanotum; prominent fascia on dorsum and posterior surface of propodeum; lateral angles and sides of propodeum; metapleura; broad triangular spot on mesopleura; broad continuous fasciae on tergites 1-4, the first bearing a pair of round anterior emarginations that are almost inclosed, second and third each inclosing a pair of dorsal spots, fourth biemarginate on anterior border; pair of large lateral spots on fifth tergite; lateral spots on sternites 2-5; pair of conspicuous spots on anterior coxae; femora, save for a line on each above and below; tibiae, save line on each below; and tarsi; *bright yellow*.

The antenna is wholly black. The sixth sternite is slightly carinate along the midline and the punctures on either side this median area are much coarser at the apex of the sternite than at the base. The sixth tergite is roundly pointed at the apex and is thickly and coarsely punctate, except along a narrow median line. The lateral borders of the tergite bear numerous short, stiff spines.

In this species the wings of the male are hyaline, those of the female slightly and uniformly infumated. The pubescence is short

and white, conspicuous on head and propodeum, less so on the side of the thorax. The variation in maculations is not great. The black on the base of the clypeus is always more extensive on the female than on the male, and on some females it is more extensive than on others. On most of the males the anterior orbits are represented only by a pair of spots in line with those below the anterior ocellus, but on others they are more or less well developed. On some males the scape is yellow below. The maculations on the males from Deesa vary from pale yellow to pale creamy white and the fasciae on the tergites show both shades of color. The males from Burma, however, do not show this variation. On the females this variation is much less evident. On two of the males from Deesa the process on the second sternite is much better developed than on the type; in fact, it presents a large well-developed tubercle. On these two specimens and on one other the second sternite is marked by a well-developed posterior yellow fascia. On one female the fifth tergite bears a continuous fascia and on two the fascia on the first tergite is interrupted.

Length 15 mm. Described from 9 males and 13 females, of which 4 males and 9 females, including the type and allotype, are from Deesa, India; 5 males and 3 females from Tavoy, Burma; and 1 female from Sikhim. This last and those from Tavoy were collected by Bingham.

*Type*.—Cat. No. 40842, U.S.N.M.

**BEMBIX MISERABILIS, new species**

Figures 138-140

*Type* (male).—Black: labrum; mandibles, except tips; clypeus; scape below; broken line on middle of frons; broad anterior orbits shortened above; posterior orbits; posterior border of pronotum connected with spot on side; tubercles in part; short, narrow line on scutum above base of wing; fascia on posterior border of scutellum; fascia on metanotum; curved fascia or dorsum of propodeum extended on its posterior surface; lateral angles and small spot on side of propodeum; three spots on mesopleura; broad continuous fasciae on all tergites, the first much narrowed medially, the others biemarginate on anterior border, the posterior ones only slightly so; lateral spots joined by apical lines on sternites 2-6; medial spot on sternites 2-4; legs, with exception of black spot on coxae and trochanters and black line on posterior surface of anterior femora; *yellow*.

The flagellum is broadened apically and the last five segments are roundly spinose on posterior border (fig. 140), and are excavated below. The intermediate femora are distinctly dentate. The second sternite bears a small, median, compressed process and the sixth a small, pointed process. The seventh sternite, which is relatively

broad and is slightly emarginate at the apex, also bears a median well-developed process, such as is usually found on the sixth in other species. The eighth terminates in a comparatively broad, flattened, bluntly-pointed spine, differing thus from most species in which the eighth terminates in a rounded acutely-pointed spine. The seventh tergite is abruptly narrowed and rather sharply-pointed apically (fig. 139).

*Allotype*.—The female so closely resembles the male in color and markings as to render a separate description unnecessary. On the dorsal areas and the sides the maculations are somewhat better developed than on the male, but on the sternites they are more reduced. The black on the legs is more extensive, lines being present on the posterior surfaces of all tibiae and femora and on the anterior surface of the posterior femora.

The wings in this species are hyaline and the pubescence normal. The color of the maculations as seen on the specimens is a soiled muddy yellow, but I am certain that these specimens have been damaged so that they do not represent the true color of the living insect.

Length 20 mm. Described from one male and one female from Japan.

*Type*.—In collection of Cornell University.

BEMBIX HAMATA C. L. Fox

Figures 110-112

*Bembix hamata* C. L. Fox, Psyche, vol. 30, 1923, p. 6.

This species is closely related to *Bembix nubilipennis* Cresson. Like that species, it has the middle femora irregularly dentate, segments 7 and 8 of the flagellum prominently spinose, and sternite 6 with small, though evident, lateral processes in addition to the median process. It differs from *nubilipennis* in the form of the genital stipes and in the character of the maculations. On this species the thorax and propodeum are entirely black, while on *nubilipennis* the prothorax is more or less profusely marked with yellow. The pubescence is much more conspicuous than on *nubilipennis*.

This species was described from males taken at San Miguel Island, Calif.

BEMBIX NUBILIPENNIS Cresson

*Bembix nubilipennis* CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 218.—

HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 102, 1893, p. 838.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 509.

*Bembix nubilipennis* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 87.

The female of this species has the base and the apex of the wings clear, but the middle portion heavily infumated, while the wings of

the male are but slightly infumated or, in the majority of specimens, entirely clear. The male may be distinguished from other North American species, except *insularis*, *infumata* and *hamata*, by the presence of lateral processes on the sixth sternite. From *insularis* it may be distinguished by the character of the genital stipes and by the fact that the fasciae on the tergites of *insularis* are white, whereas on this species they are yellow. The female of this species is not likely to be confused with any other North American species except *melanaspis*, which is distinguished from it by having more or less black on the clypeus, whereas *nubilipennis* has the clypeus wholly yellow.

## SPECIMENS EXAMINED

COLORADO: Walsenburg.

ILLINOIS: Jacksonville (July, 1900, Crain).

IOWA: Fairfield (T. C. Ross).

KANSAS: Wilson (August, 1909, J. B. Parker).

MEXICO: Lerdo, Durango (June 10, 1918).

NEBRASKA: Grand Island (July 5, 1897).

NEW MEXICO: Koehler (W. H. Walton).

OKLAHOMA: Durant (June, 1905, F. C. Bishopp).

TENNESSEE.

TEXAS: Bryant; Childress (September 1, 1908, E. S. Tucker); Corsicana (May 16, 1907, R. A. Cushman); Marfa (June 6, 1908, Mitchell and Cushman); Paris (A. L. Melander); Plano (July 14, 1907, E. S. Tucker); Wichita Falls (June 10, 1906, J. D. Mitchell).

## BEMBIX MERCETI, new name

• Figures 129-133

*Bembex handlirschi* MERCET, Bol. R. Soc. esp. Hist. nat., 1904, p. 343 (not Cameron, Fauna and Geography of Maldive and Laccadive Archipelago, vol. 1, Pt. 1, 1901, p. 57).

There are in the United States National Museum a male and a female of this species identified by Mercet and received from him in an exchange. The male of this species is well marked. The anterior tibia at its distal end is somewhat dilated; the middle tibia is distinctly curved, the concave surface being on the outer side, and its anterior distal border at the apex is produced into a spinelike process that subtends a short spine; the distal end of the middle metatarsus is distinctly flattened; the posterior border of the middle femur is dentate. Both second and sixth sternites bear processes and the seventh sternite bears prominent lateral carinae and a broad median longitudinal area resembling somewhat a process. The seventh tergite is broadly rounded at the apex and bears a short, median, apical, dorsal depression. At the posterior lateral angles of



this tergite lateral ridges are developed, below which the angles are broadly rounded and directed ventrally.

The female resembles the male in color but the ultimate tergite is greatly narrowed and provided with short lateral ridges near the apex, which is almost squarely truncate. On both male and female the inner eye-margins are divergent at the clypeus, and the anterior metatarsus is provided with 10 spines, of which the three proximal ones are smaller than the others. These specimens bear the label, "Madrid, G. Mercet."

**BEMBIX REGNATA, new species**

Figures 179-183

*Type* (male).—Black: labrum; clypeus, except a pair of small basal spots; mandibles, except tips; scape; space between and above antennae; transverse line below anterior ocellus; broad anterior orbits shortened above; broad posterior orbits much narrowed above; prothorax, except a series of dorsal spots; lateral line above base of wings and a pair of short narrow discal lines on scutum; narrow fascia on posterior border of scutellum; narrow fascia on metanotum; curved fascia on dorsum of propodeum extended downward on its posterior surface; lateral angles and sides of propodeum; metapleura; mesopleura and mesosternum almost wholly; interrupted fascia on first tergite much narrowed toward the midline; continuous fasciae on tergites 2-6, very broadly emarginate on anterior dorsal border; lateral spots on sternites 2-5; legs, except line above on femora of first and third pairs and small spots near the junction of femur and tibia of all pairs; *yellow*, the fasciae on the tergites being pale rather than bright yellow.

The flagellum is dark above, lighter below and toward the apex. Its segments are neither spinose nor excavated but segments 10 and 11 are flattened. The apical segment is slightly curved and roundly truncate at the apex. The middle femora are dentate, being provided with a number of widely separated spinelike teeth. The middle tibia has its anterior apical border prolonged into a curved toothlike process which bears at its apex a short spine. Near its middle this tibia also shows a slight enlargement or swelling below. The second sternite bears a prominent, blunt, keel-shaped process and the sixth a flattened triangular elevation from the apex of which a slight carina extends to the apex of the sternite. The seventh tergite is narrowed and broadly rounded at the apex and covered with numerous coarse punctures. The eighth sternite ends in a short, thin, flat, blunt spine. The genitalia (fig. 182) are distinct.

*Allotype* (female).—Black: labrum; mandibles, except tips; clypeus, except pair of small basal marks; frons between antennae; elliptical spot below anterior ocellus; anterior orbits narrowed and shortened above; scape, except small apical spot above; posterior orbits narrowed and interrupted above; posterior border of prothorax including tubercles; lateral lines and U-shaped discal mark on scutum; narrow fascia on posterior border of scutellum; fascia on metanotum; curved fascia on propodeum; small spot on mesopleura; interrupted fascia on first tergite greatly narrowed at midline; continuous fasciae on tergites 2–5, deeply and roundly biemarginate on anterior dorsal border and acutely emarginate at midline on posterior border; sixth tergite; small lateral spots on sternites 2–4; apex of femora in part; tibiae, except line below; and tarsi; *yellow*. The labrum, clypeus, scape, and anterior orbits are pale rather than yellow.

The flagellum is ferruginous with the first and second segments black above.

The frons in this species is distinctly carinate and the carina is continued on the base of the clypeus. The wings are remarkably short and hyaline, though the abundance of short hairs upon the surface causes them to appear slightly infumated. The second intercubitus is only slightly bent on both sexes, but is less so on the female than on the male. The pubescence is very short and inconspicuous. The anterior metatarsus is provided with seven spines. The second sternite of the female is shining and thickly set with coarse punctures. The sixth tergite, except near the apex, which is triangular and roundly pointed, is covered with long, fine hair, among which laterally are a number of stout, spinelike hairs. The inner eye-margins are almost parallel, being only very slightly divergent at the clypeus.

Length about 20 mm. Described from two specimens from eastern Africa. The type bears the label, "D. O. Afrika, Usaramo, Rufiaji Klurtusteppe, X—XI, Gotze S." The allotype bears the label, "Njassa See, Langenburg, 20—25, V. 99, Dr. Fütteborn S."

*Type*.—In the Zoologisches Museum der Universität, Berlin.

**BEMBIX SPATULATA, new species**

Figures 193–195

*Type* (male).—Black: labrum; mandibles, except tips; clypeus; scape below; frons to level of anterior ocellus, except central black spot; posterior orbits; prothorax almost entirely; broken U-shaped discal mark and short lateral lines at base of wings on scutum; narrow fascia on posterior border of scutellum enlarged at ends; narrow fascia on metanotum; narrow curved fascia, interrupted medially on

dorsum of propodeum; metapleura; mesopleura, except small rounded black spot; continuous faciae on tergites 1-6, first narrowed medially, second, third, and fourth biemarginate dorsally; apex of seventh tergite; sternites 1-3 entirely; broad fascia on each of fourth and fifth emarginate medially; the legs, except for black spots on posterior surface of trochanters and lines on posterior surfaces of femora and tibiae and apical dark spots on the underside of all tarsal segments; *very pale yellow or white*.

The flagellum is dark above, testaceous below and its sixth, seventh, and eighth segments are slightly spinose. The apical segment is slightly curved, narrowed, and rounded at the apex. The intermediate femora are dentate and the anterior border of the intermediate tibia at the apex is drawn out into a spinelike process that bears a prominent spine. The second sternite bears a prominent, laterally compressed process and the sixth a small triangular process. The seventh sternite is broad, squarely truncate at the apex and spatulate in form. It bears a median V-shaped carina and a pair of lesser lateral carinae.

*Allotype*.—Black: labrum; mandibles, except tips; clypeus; scape below; frons to level of anterior ocellus, save a pair of black spots; posterior orbits broad below; prothorax, save anterior part of pronotum; broken U-shaped discal mark and lateral lines above base of wings on scutum; fascia on posterior border of scutellum enlarged at the ends; fascia on metanotum; curved fascia on dorsum and posterior surface of propodeum; sides of same; metapleura; mesopleura; broad continuous fasciae on tergites 1-5, first narrowed medially, second inclosing a pair of dorsal black spots, third, fourth, and fifth, each biemarginate on anterior dorsal margin; apex of sixth tergite; sternites 1-4; broad fascia on fifth; pair of minute apical spots on sixth; legs except for black lines on all trochanters, femora, and tibiae; *yellow or very pale yellow*.

The pubescence on this species is white, short, and sparse, save on the head and propodeum. On abdominal segments 6 and 7 of the male it is more evident than is usually the case. The maculations on the male vary somewhat. On some specimens the U-shaped discal mark is reduced to a pair of lines and on others it is entirely lacking. The tergal fasciae usually show two colors, yellow on the anterior border and white on the posterior, with the white occupying the greater portion of the fascia. The form of the genital stipes (fig. 194) and the seventh sternite of the male render this species easy to identify.

Length 13-15 mm. Described from 13 males and 1 female from Quetta, India.

*Type, allotype, and paratypes*.—Cat. No. 40843, U.S.N.M.

## BEMBIX ROSTRATA Linnaeus

Figures 187-189

*Apis rostrata* LINNAEUS, Oelandska och Gothlandska Resa, 1745, p. 246.

*Bembex rostrata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 764.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 512.

According to Handlirsch, this species is one of the most numerous and most widely distributed of the palearctic group, being distributed from the Mediterranean to Scandinavia and from Portugal to Mongolia. The male is strongly characterized by the dentate middle femur, the deeply excavated and dilated last three segments of the flagellum, the tuberculate second and sixth sternites, and the strong carina of the seventh sternite, which, at the apex of the segment, terminates in a two-pointed process. Of the five males before me these structural characters are constant but variation in the maculations is great. On one specimen the fasciae on the tergites are broad and all except the first are continuous; on another they are narrow and all are interrupted at the midline. One male bears the label, "Europe"; two bear the label, "Germany"; the fourth bears the label, "Aranjuez, G. Mercet"; and the fifth bears the label, "Gray." A single female before me, which bears the label, "Los Molinos, G. Mercet," has the fasciae on the tergites creamy white instead of yellow as on the males.

## BEMBIX PICTICOLLIS Morawitz

Figures 159-161

*Bembex picticollis* MORAWITZ, Horae soc. Ent. Ross., vol. 23, 1889, p. 144.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 767.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 511.

This species is closely related to *Bembix rostrata* Linnaeus. With regard to the form and structure of the antennae, middle femora, and the genitalia, the two species are almost identical and their resemblance in the color and character of their maculations is quite close. The form of the seventh sternite on the two species is quite different: On *rostrata* this sternite bears a distinct, median, longitudinal carina that is bifurcate at the apex, whereas the carina on this sternite on *picticollis* is simple and does not reach the apex of the sternite. The form of the spine on the eighth sternite is also different: On *rostrata* the spine is long, curved, and pointed in the normal fashion, whereas on *picticollis*, although it is sharply pointed, it is short, straight, and broadly flattened. The form of the seventh tergite is also different as is shown by Figures 161 and 189.

This species is represented in the United States National Museum by three males, each bearing the label, "Uen Chuen Szechuen, China, Aug. 3-6, 1924, D. C. Graham, Coll., altitude 4,500-5,500 feet."

**BEMBIX MEGERLEI** Dahlbom

*Bembex megerlei* DAHLBOM, Hym. Europ., vol. 1, 1845, p. 492.—HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 729.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 508.

Of this species I have at hand one male and two females, each bearing the label, "Austria." The male of this species may readily be distinguished by the characters found on the middle femur and metatarsus: The femur is dentate below with the middle tooth, the longest one in the row and the metatarsus below at its middle point bears two stout spines and the distal part beyond the spines is slightly curved. The second and sixth sternites bear moderately developed tubercles and the seventh a broad, median carina. The dorsal border of the clypeus is black and from the center the black is extended to form a large median spot. The mesothorax, metathorax, and propodeum are wholly black and the maculations on the abdomen are confined to narrow lateral spots on tergites 1-3.

On the females the fasciae on the tergites are pale, relatively broad, and all continuous on one specimen and all but the fourth continuous on the other. On both specimens the fifth tergite bears only a pair of small round discal spots and the sixth an apical spot. On one there is a narrow, interrupted fascia on the scutellum, traces of an interrupted fascia on the metanotum, pair of large spots on posterior part of the propodeum, a very large spot on the side of the propodeum and another on the metapleura. The side of the prothorax on this specimen is almost entirely pale. On the other female these same maculations are present but are greatly reduced, especially on the scutellum, metanotum, and dorsum of propodeum. On the sternites, maculations are limited on both females to lateral spots on two and three and to extreme tip of six. On both males and females the second abscissa of the cubitella is lacking.

**BEMBIX MELANOPA** Handlirsch

*Bembex melanopa* HANDLIERSCH, Sitz. Akad. Wissensch. Wien, Mat.-Nat. Cl., vol. 102, 1893, p. 797.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 508.

I have at hand two males and two females that I have referred to this species, and also two males determined by R. H. R. Stevenson. The peculiar form of the genital stipes, the form of the terminal segment of the antenna, the position of the teeth on the posterior border of the middle femur, together with the black antennae and

black face, form a combination of characters that readily distinguishes the male of this species. The female is more difficult to separate from related forms; its black face and black antenna (except tip of flagellum), the interrupted fascia on the fifth tergite, and the reduced or obsolete second abscissa of the cubitella vein are its most conspicuous characters. Four of the specimens bear the following labels: "Nyassa-See, Langenburg, III. 98, Fülleborn S"; "Nyassa-See, Langenburg, 20.VIII.-1.IX.98, Fülleborn S"; "Kap Kolonie"; and "D. Ost-Afrika, Stuhlmann S." The two males determined by Stevenson bear the labels: "Sawmills, S. Rhodesia, 22-27, Dec., 1923, R. H. R. Stevenson"; and "Bulawayo, 13, 9, 1923, R. Stevenson."

**BEMBIX FORCIPATA** Handlirsch

Figures 97-99

*Bembex forcipata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 798.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 505.

This species differs from *melanopa* apparently only in the extent of the maculations. The clypeus is largely yellow, the labrum wholly so, and the sides of the thorax are more or less conspicuously maculated. I have before me three males and one female that I have referred to this species. They bear the following labels: "Dar es Salaam, Aug.-Sept., 1902, Meinhof S."; "D. Ostafrika, mikindani, IV-V, 1911, H. Grote S. G."; "D. Ost-Afrika, Stuhlmann S."; and "D. O. Afrika, Hinter Waldungen von Dar-es-Salaam, Schulze V."

**BEMBIX FRIOENSIS**, new species

Figures 100, 101

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except pair of black spots; lower part of frons, continued upward on midline to join spot below anterior ocellus; small round spot on either side this large spot; anterior orbits, deflected inward opposite anterior ocellus; scape below; posterior orbits narrowed above; prothorax, except pair of anterior dorsal spots and dusky spot in front of tubercles; broad lateral lines on scutum; pair of broad discal lines and an interrupted transverse posterior line, forming a broken U-shaped discal mark on scutum; fascia on posterior border of scutellum narrowed at midline; fascia on metanotum; curved fascia on propodeum, interrupted at midline on posterior surface; posterior-lateral angles and sides of propodeum; metapleura; mesopleura, fasciae on tergites 1-6, all interrupted at midline, first narrowed medially, second and third each inclosing pair of black discal spots,

fourth, and fifth biemarginate on anterior dorsal border; pair of spots on apex of seventh tergite; second sternite, except pair of anterior black spots and large medial longitudinal black spot; lateral spots on sternites 3-5 joined by narrow apical lines; coxae and trochanters for the most part; femora, except line above on anterior pair and basal spots on all; tibiae, except small basal spot on all and small spot below on anterior pair; and tarsi; *yellow*.

The posterior border of the middle femur on its apical half is weakly dentate, the teeth being small, short, and blunt. The flagellum is black and is neither spinose nor excavated, but segments 5-11 show specialized areas below and the apex of the terminal segment is rufous. The second sternite bears a median, sharp-pointed, prominent process, and the sixth, a short, broad and bluntly pointed process that is slightly concave on its ventral surface. The seventh sternite bears a median carina and at the base a pair of inconspicuous lateral carinae. The genital stipes is distinct in form and bears a conspicuous yellow maculation.

The *allotype* (female) in color differs but little from the type; the scutellum bears lateral spots instead of a fascia; only the fascia on the second tergite incloses black spots; and the lateral spots on the sternites are somewhat less extensive. The sixth tergite at its apex bears a pair of yellow spots. The sixth sternite on the mid-longitudinal line is destitute of punctures, but laterally at the base it is densely and finely punctate, while at the apex the punctures are very coarse. As on the type, the flagellum is black with the apex of the terminal segment rufous.

The wings of this species are hyaline and the pubescence white in color and normal in development. The frons between the antennae is but slightly carinate, and the clypeus is only moderately arched. Among the paratypes is a female, from the same locality as the type, that has the sixth tergite black, the anterior orbits interrupted, and, together with a second female from the same locality, has the black spots on the clypeus joined. Two male paratypes from Piura, Peru, have the maculations in general much better developed. On these specimens the black on the clypeus is lacking, the fasciae on tergites two and three inclose black discal spots, and those on tergites one and six are continuous. These two agree with the type in having the genital stipes maculated.

Length 16 mm. Described from three males and ten females. Of these the type, allotype, and five female paratypes bear the label, "Rio Frio, Colombia, March 1924, H. W. Atkinson, Collector." The two male paratypes bear the label, "Piura, Peru, fls. Asclepiad Vine, April 28, 1911 (Townsend)." Of the remaining females two bear

the label, "Chauchaumayo, Peru, from W. F. H. Rosenberg," and two bear the label, "Tabernilla, Canal Zone, Panama, IV, 1911, A. H. Jennings, Coll."

*Type*.—Cat. No. 40844, U.S.N.M.

**BEMBIX OCHRACEA Handlirsch**

Figures 146-148

*Bembix ochracea* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 864.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 509.

The single male specimen that I have doubtfully referred to this species agrees in most respects with Handlirsch's description. It differs in having no fascia on the propodeum; in having a pair of obscure yellow spots on the seventh tergite; and in having on the sternites well-developed fasciae, of which that on the second sternite is quite broad and those on the other sternites are broad laterally but are narrowed conspicuously at the midline. These differences in the extent of the maculations are well within the limits of variation found in species of this genus. Handlirsch's type lacked complete antennae. Segments 7-11 of the flagellum of this specimen are excavated below and segments 7-9 are spinose. Segment 11 is somewhat dilated and the terminal segment is short, strongly curved and roundly truncate at the apex. The form of the seventh tergite is shown in Figure 148 and the form of the genitalia in Figure 147. The specimen, which is the property of the Zoologisches Museum der Universitate, Berlin, bears the label "Cap Myers" and the number 21616.

**BEMBIX FESTIVA, new species**

Figures 91-93

*Type* (male).—Black: labrum; clypeus; mandibles, except tips; scape below; area on frons between antennae ending in a point above; spot below anterior ocellus; broad but short anterior orbits; posterior orbits; posterior border of pronotum joined with tubercles; sides of prothorax, except long irregular spot in front of tubercles; small lateral spot on scutum above base of wings; small lateral spots on scutellum: broad fasciae on tergites 1-7, first narrowly interrupted at midline, second inclosing pair of narrow discal spots and narrowed somewhat at midline, third biemarginate on anterior dorsal border and sinuate at midline on posterior border, fourth emarginate at midline on posterior border, seventh biemarginate laterally on anterior border; lateral spots on sternites 2-6 and median spots on 2-4, of which those on 2 and 3 are joined to the corresponding lateral



spots by apical lines; femora, except more or less of the proximal half; tibiae; and tarsi; *yellow*.

The wings are hyaline. The pubescence is white, rather short, and dense. It is very short, but unusually conspicuous on all segments of the abdomen. The flagellum is black above, light yellowish below, and segments 5-9 are spinose below. Segments 10 and 11 are slightly excavated below. The posterior border of the middle femur is dentate except near the proximal end. The second sternite bears a prominent, median, laterally compressed process that ends in a short, curved sharp point. The sixth sternite bears a prominent, narrowed, median, bluntly pointed process whose ventral surface is grooved. The seventh sternite bears a median longitudinal carina that reaches the posterior end of the sternite and assumes almost the proportions of a process. The anterior metatarsus bears six spines.

In general appearance this species resembles *nubilipennis* but may readily be distinguished from that species by the absence of lateral processes on the sixth sternite. It also resembles somewhat the male of *connexa* but differs from that species in having the propodeum, metanotum, metapleura, and mesopleura wholly black.

Length 18 mm. Described from a single male bearing the label, "Oak Creek Canon, Ariz., 6,000 feet, July, F. H. Snow."

*Type*.—In the collection of the University of Kansas.

#### BEMBIX MUSCICAPA Handlirsch

*Bembex muscicapa* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 102, 1893, p. 828.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 509.

*Bembex sayi* FOX, Proc. Acad. Nat. Sci. Phila., 1895, p. 359.

*Bembex foxi* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 96.

This species is conspicuous for the distribution of its maculations. The sides of the thorax and propodeum are profusely maculated and the scutum bears more or less well-developed discal and lateral lines, but the scutellum, metanotum, and dorsum of the propodeum are, in the male, entirely black and in the female only the scutellum bears lateral spots. On some females there are yellow spots on the posterior surface of the propodeum. The male is also distinguished by the large, long, curved, sharp-pointed process on the second sternite. The fascia on the first tergite on both sexes is always narrower than the others and is always more or less widely interrupted, but any of the other fasciae may be weakly connected or all may be interrupted. The third, fourth, and fifth are most frequently connected at the midline.

In the collection of the United States National Museum there are eight males and eight females of this species, all from Porto Rico.

The specimens on which I based my description of *B. fovi*, according to the labels they bear, were from Illinois. Is it possible that the placing of the labels upon these specimens is the result of a mistake?

BEMBIX NIPONICA Smith

Figure 145

*Bembex niponica* SMITH, Trans. Ent. Soc. London, 1873, p. 194.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 509.

In the collection of the United States National Museum is a single male that has been determined as this species, but by whom the determination was made is unknown. I have compared the specimen with the original description of the species and am convinced that the determination is correct. The specimen bears the label, "Sapporo Agr. Coll., Dec., '96, Japan, M. Matsumura."

The following is a detailed description of this male: Black: clypeus; labrum; mandibles, except tips; anterior orbits shortened above; area below antennae and space between them extended upward; scape below (flagella broken off); posterior orbits narrowed above; irregular band on posterior border of pronotum and posterior border of tubercles connected by a large irregular spot on side of prothorax; short narrow lateral lines on scutum above base of wings; fascia on posterior border of scutellum; fascia on metanotum; narrow, curved fascia on propodeum, interrupted at midline on its posterior surface; small spot on posterior lateral angles of propodeum; small spot on mesopleura below wings; broad, continuous fasciae on tergites 1-6, that on second tergite inclosing pair of black discal spots; apex of seventh tergite; lateral spots and median spot on sternite 2 connected by an apical line; lateral spots and median spot on sternite 3; lateral spots on sternites 4 and 5 connected by very narrow apical lines; large lateral spots on 6; lateral spots on 7; coxae and trochanters in part; femora, except black line on posterior surface of first pair and basal black spot on anterior surface of third pair; tibiae; and tarsi; *pale grayish yellow*.

The middle femora are distinctly dentate. The middle tibia is angulate below, giving rise almost to a longitudinal carina. The wings are hyaline and the second abscissa of both radiella and cubitella is present. The second sternite bears a well-developed median process; the sixth bears a small one and the seventh also bears a process as well developed as that on the sixth. The seventh tergite laterally is slightly sinuate, and is abruptly narrowed toward the apex, which is squarely truncate. The spine of the eighth sternite is short and broad, in form resembling somewhat a spearhead.

Length 20 mm.

**BEMBIX FLAVESCENS** Smith

*Bembex flavescens* SMITH, Cat. Hym. Ins. Brit. Mus., vol. 4, 1856, p. 321.—  
HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p.  
862.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 504.

Of this species I have before me two specimens, a male and a female, received by the United States National Museum in an exchange, but by whom they were determined is not shown. They agree quite closely with Handlirsch's description of the species. The male differs from Smith's description of the male only in the absence of discal lines on the scutum. They bear a common label, "Gomera (Canar. Ins.), Hintz V. 15. IV. 98." This species has been reported only from the Canary Islands.

**BEMBIX CONNEXA** Fox

*Bembex connexus* FOX, Proc. Acad. Nat. Sci. Phila., 1895, p. 360.  
*Bembix connexa* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 115.

In the collection of the United States National Museum are six females that I have referred to this species. They are large and robust with the maculations bright greenish yellow. In this respect they differ from Fox's type, on which the fasciae on the tergites are whitish. They agree with the type, however, in having the sides of the thorax and propodeum extensively maculated, while having the scutum, scutellum, metanotum, and dorsum of propodeum either entirely black or with only minute lateral spots on the scutum and scutellum. The male is known only by the single specimen on which Fox based his description of the male of the species. The yellow color of this male is similar to that of *occidentalis*. The middle femur is strongly dentate below; segments 7-10 of the flagellum are slightly, though evidently, spinose, segments 7 and 8 being more prominently so; the processes on sternites 2 and 6 are well developed and pointed; and there are evident rounded lateral ridges on the basal half of the sixth sternite, but they do not constitute lateral processes. The maculations on the dorsum of the thorax and propodeum are somewhat more extensive than on the female.

## SPECIMENS EXAMINED

CALIFORNIA: Los Angeles County (July, Coquillett); Mariposa County (Coquillett).  
NEVADA: Reno (July 26, 1889, F. H. Hillman).  
UTAH: South Creek, Beaver County.

**BEMBIX LATIFRONS** Parker

*Bembix latifrons* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 116.

This species is not represented at the United States National Museum. It is known only from the type (female) in the collection of the University of Kansas.

## SPECIMENS EXAMINED

NEW MEXICO: Albuquerque (1894, F. H. Snow).

**BEMBIX GRADILIS, new species**

*Type* (male).—Black: labrum; mandibles, except tips; clypeus; scape below; lower part of frons extended upward from between the antennae; broad anterior orbits shortened above; transverse series of three spots below anterior ocellus; narrow posterior orbits; narrow posterior border of pronotum continued on tubercles; spot on sides of prothorax; small lateral spot above base of wings and pair of short, narrow discal lines on scutum; lateral spots on scutellum; fascia on metanotum; short oblique lateral lines on dorsum of propodeum; spot on lateral angles of propodeum; small spot on metapleura; narrow vertical line broken into two spots on mesopleura: interrupted fasciae on tergites 1–5, all except the first more or less broadly bisinuate on anterior border; lateral spots on sternites 2–5, decreasing in size from two to five; conspicuous spot on anterior coxae; femora, except black line above on all and short line below on second and third pairs; tibiae; and tarsi; *yellow*. The lateral spots on the scutellum and fascia on metanotum are *white*.

The flagellum is black above, somewhat testaceous below, and its segments are all without modifications. The middle femora are weakly dentate below. The second sternite bears a median longitudinal carina that may be regarded as a poorly developed tubercle. The sixth sternite bears a small, short, sharp-pointed, median process and the seventh is carinate on the midline. The wings are hyaline. The pubescence is normal in development, being longest on head, thorax, and propodeum. The paratype differs from the type in lacking discal lines on the scutum and spots on the lateral angles of the propodeum, and in having the maculations on the mesothorax reduced.

This species runs in Handlirsch's table to *Bembex inops* Handlirsch and it is possible that this may be only a yellow form of that species. All maculations, except those on the scutellum and metanotum, are bright yellow and the genital stipes in form differs somewhat from the figure given by Handlirsch of the stipes of *inops*.

Length 16 mm. Described from two males (type and paratype) bearing the label, "Paso del Libres Carrientes, Argentina, January 12–14, 1920, Cornell Univ. Exped."

*Type*.—In the collection of Cornell University.

**BEMBIX SPINOLAE Lapeletier**

*Bembex spinolae* LEBELETIER. Hist. Nat., vol. 3, 1845, p. 227.

*Bembex fasciata* DAHLBOM. Hym. Eur., vol. 1, 1845, p. 487.

- Bembex spinolae* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 285.—FOX, Proc. Acad. Nat. Sci. Phila., 1895, p. 357.—  
DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 514.  
*Bembix spinolae* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 98.

This is the most widely distributed species of the genus in North America. This species, *similans* Fox, *primaestate* Johnson and Rohwer, *cameroni* Rohwer, and *comata* Parker form a group of overlapping species that present considerable difficulty to the student of the taxonomy of these wasps. Typical specimens of these species can readily be distinguished from each of the other species, but it is by no means an uncommon occurrence to find specimens that may be referred to two or more of these species and can not with certainty be referred to any one of them. This state of affairs raises the question of the validity of some of these species, but it is a question that must depend for an answer upon more work in the field; it is a question that can not be answered by an examination of dried specimens stuck on pins.

*Bembix spinolae* occurs in the eastern part of the United States and Canada and has been reported in the east from Ontario to Florida and in the west from the Dakotas to Texas. With the exception of one report of *similans* from Florida, all the other species in this group are found in the mountainous western part of the country or on the west coast. I have, however, examined specimens from the western area, taken along with typical examples of *comata* and *primaestate*, that must be considered examples of *spinolae*. I have examined other specimens also from the West that could not with certainty, in the light of our present knowledge of this group, be referred to any one of these species. A short study of the nesting habits of *B. comata* Parker, which I made at San Francisco during the summer of 1925, showed that this species differs in its mode of constructing its nest from *B. spinolae* Lepelletier, whose nesting habits I have studied in the District of Columbia. I am of the opinion that further studies of this kind in the field must be made before the relationship of the species in this group and the validity of the species themselves can be satisfactorily determined.

#### BEMBIX CAMERONI Rohwer

- Bembix cameroni* ROHWER, Proc. U. S. Nat. Mus., vol. 41, 1912, p. 467.  
*Bembix cameroni* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 99.

This species is somewhat more robust than *spinolae* and is also marked with maculations of much richer yellow. The males can be distinguished from the males of closely related species by the fact that the fifth segment of the flagellum is spinose. The females may be distinguished from those of related species by the broad yellow

fasciae of the tergites, the maculated sixth tergite, and the absence of maculations on the sides of the mesothorax and propodeum. From *nubilipennis* the male of this species may be distinguished by the absence of lateral processes on the sixth sternite and the female by its clear wings.

## SPECIMENS EXAMINED

ARIZONA: Oak Creek Canon (August, F. H. Snow).

MEXICO: Federal District (October 7 and 8, C. F. Baker).

NEW MEXICO: High Rolls (June 12, 1902); White Oaks (August 2, 1903).

## BEMBIX COMATA Parker

*Bembix comata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 100.

Typical forms of this species, both males and females, have the fasciae white in color and the terminal tergite maculated. The pubescence on the head, thorax, propodeum, and base of abdomen is much better developed than in the case of *spinolae*, being long, dense, and white. Recent collections by C. L. Fox indicate that this species also appears with yellow fasciae instead of white. It differs from *primaestate* in the absence of conspicuous maculations on the sides of the thorax and propodeum, but among the numbers collected by Mr. Fox are some specimens that stand on the border line between these two species, not agreeing with typical forms of either species, yet showing some characteristics of both. A brief study of the nesting habits of *comata* showed that this species in rearing its young constructs a burrow in which it provides several brood chambers, one for each egg deposited. In this respect it differs from *spinolae*, which species constructs a new burrow for each egg deposited; that is, rears only a single young in each burrow.

## SPECIMENS EXAMINED

CALIFORNIA: Claremont: Los Angeles County (Coquillett): San Francisco (July, 1925, J. B. Parker).

NEVADA: Reno (August 30, 1889, F. H. Hillman).

NEW MEXICO.

OREGON: Forest Grove (July 21, 1918, M. C. Lane); Van Sickle Canyon (September 13, 1904, E. S. G. Titus).

WASHINGTON: Kalliotus (August 18, 1920, M. C. Lane); Lake McElroy, Poha (July 20, 1920, M. C. Lane); Spokane (July 7, 1924, J. M. Aldrich); Stratford (September 3, 1920, M. C. Lane).

## BEMBIX PRIMAESTATE Johnson and Rohwer

*Bembix primaestate* JOHNSON and ROHWER. Ent. News, vol. 19, 1908, p. 378.—ROHWER, Proc. U. S. Nat. Mus., vol. 41, 1912, p. 466.

*Bembix primaestate* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 101.

This species seems to be intermediate between the eastern *spinolae* and the western *comata*. The females must be separated from

*spinolae* on the color and extent of the maculations, and it frequently happens that specimens are taken that can not with certainty be referred to either species by the use of any keys so far devised. Likewise many males are found that seem to be intermediate between this species and the males of *similans* Fox and thus present the same difficulties in identification. Consequently no keys, even the one I have prepared herewith, can be depended upon absolutely in making identifications among these closely related species.

## SPECIMENS EXAMINED

ALBERTA: Medicine Hat (August 20, 1916, Sladen).  
 ARIZONA: Oak Creek Canyon (F. H. Snow).  
 BRITISH COLUMBIA: Vancouver (August 9, 1916, Livingston).  
 COLORADO: Boulder (September 13, 1907, S. A. Rohwer); Denver (June 13, 1902).  
 IDAHO: Springfield (July 30, 1906, S. A. Snyder).  
 LOUISIANA: East Point (September 5, 1907, F. C. Bishopp).  
 MEXICO: Guadalajara (June 19, 1903, McClendon).  
 NEVADA: Reno (August 28, 1889, F. H. Hillman).  
 NEW MEXICO: Fort Wingate (July 15, 1909, John Woodgate); High Rolls (June 11, 1902).  
 TEXAS: Midland (June 16, 1909, F. C. Bishopp); Rosser (August 23, 1905, F. C. Bishopp); Victoria (September 11, W. A. Hooper).  
 WASHINGTON: Friday Harbor (June 19-26, 1909); Olga (July 15-31, 1909); Seattle.

## BEMBIX SIMILANS Fox

## Figure 28

*Bembex similans* Fox. Proc. Acad. Nat. Sci. Phila., 1895, p. 358.

*Bembix similans* PARKER Proc. U. S. Nat. Mus., vol. 52, 1917, p. 103.

In this species both males and females have yellow maculations, in this respect resembling *cameroni*. According to Fox's description of this species, the fifth segment of the flagellum is "dentate beneath." On none of the specimens that I have referred to this species do I find this to be true. *B. cameroni* alone of this group of closely related species has the fifth segment of the flagellum spinose beneath. The maculations on the sides of the thorax and propodeum are more extensive than on any other species of this closely related group. The specimens on which Fox based his description of the species were taken at Las Cruces, N. Mex.

## SPECIMENS EXAMINED

FLORIDA: Jacksonville (April, L. O. Howard).  
 KANSAS.  
 MEXICO: San Jose de Guaymas (April 10, L. O. Howard).  
 NEW MEXICO: Mesilla Park (C. N. Ainslie); Las Cruces (August 30, Townsend).

## BEMBIX LIBERIENSIS, new species

Figures 119-122

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except a pair of large basal spots; spot on lower side of scape; posterior orbits narrowed above and not reaching the vertex; pair of small dorsal spots on posterior border of prothorax; spot on side of prothorax; small spot on lateral angle of propodeum; widely separated lateral spot on first tergite; interrupted fascia abruptly narrowed medially on second tergite; continuous fasciae on tergites three and four, biemarginate anteriorly and deeply emarginate on posterior median line; interrupted fascia on tergite 5; pair of small lateral spots on sternite 2; spots and stripes varying in size on the legs; *pale yellow*.

The flagellum is entirely black. Segments 8 and 9 are spinose and segments 7-12 show light-colored specialized areas on posterior side. The apical segment is longer than the eleventh; in fact, is almost as long as eleventh and tenth combined; it is slightly curved and roundly pointed at the apex. The legs show no special modifications. The second sternite bears a small, sharp-pointed, median process and the sixth bears a larger, bluntly pointed, median process near the apex of the sternite. The sixth also bears a pair of conspicuous, curved, lateral carinae. The seventh sternite bears a pair of lateral, parallel carinae that do not extend to the apex of the sternite.

*Allotype*.—Black: labrum, except lateral borders basally; mandibles, except tips; apical border of clypeus; trace of anterior orbits; posterior orbits; obscure spot on lower side of scape; pair of small dorsal spots on posterior border of pronotum; spot on side of prothorax; vertical line on mesopleura; lateral angle of propodeum; widely separated lateral spots on first tergite; interrupted fasciae, all narrowed medially, on tergites 2-5, the interruption being wide on the second tergite and very narrow on the fifth; small lateral spots on sternites 1-5; stripes on femora, tibiae, and tarsi of all legs; *pale soiled yellow*.

The seventh tergite on the male is triangular in outline, narrow and truncated at the apex, whereas on the female it is rounded at the apex and is finely and uniformly punctate, except toward the apex, where the punctures are coarser and more scattered. The extreme apical portion is without punctures.

Length, 23 mm. Described from one male and one female from Liberia, Africa. The two specimens are in poor condition so that the exact shade of the maculations is uncertain.

*Type and allotype*.—Cat. No. 40845, U.S.N.M.



## BEMBIX ALBATA, new species

Figures 85, 86

*Type* (male).—Black: clypeus; labrum; mandibles, except tips; spot between antennae; scape, except broad line above; broad anterior orbits shortened above; spot on tegula; short, narrow line on scutum above tegula; broad, continuous fasciae on tergites 1–6, the first with a relatively deep, rounded anterior emargination, remaining fasciae each with a broad, shallow anterior emargination whose border is weakly trisinate; seventh tergite entirely; broad, continuous fasciae on sternites 1–6; seventh entirely: femora apically, more extensive below than above; tibiae, except spot below on first and second pairs; and tarsi; *pale yellow*.

The fasciae on the tergites are exceedingly pale, almost white; those on the sternites are more yellowish, resembling the yellow of the legs. The intermediate femora are neither serrate nor dentate and the intermediate tibiae and metatarsi are normal. The anterior metatarsus is provided with six cilia or spines. The second sternite bears a median, small, thinly compressed, sharply pointed process. On the sixth there is a peculiarly swollen area, somewhat triangular in outline with the apex on the midline near the apical border of the sternite. The segments of the flagellum lack evident spines or excavations. Genital stipes as in Figure 85.

The maculations of the *allotype* (female) are identical with those of the type, except that (1) on the tubercle there is a yellow spot that is extended downward on the posterior margin of the prothorax, (2) the yellow on the legs is more extensive, there being no black present on the middle tibiae, and (3) the basal border of both the sixth tergite and sixth sternite is black.

The wings on this species are hyaline. The frons is broad and the inner eye-margins are parallel. The mandibles are slender and the teeth on the inner margin are so much reduced that the mandibles are approximately edentate. The head, thorax, first three segments of the legs, the popodeum, and the basal part of the first abdominal segment in both sexes are covered with long, dense, hoary pubescence, giving to this species a vestiture much like that possessed by some bees.

Length, 14–17 mm. Described from five males and three females, each of which bear the label "Lüderitz-Bucht, XII, 1903, L. Schultze, S."

*Type*.—In the Zoologisches Museum der Universität, Berlin.

## BEMBIX ZONATA Klug

*Bembix zonata* KLUG, Waltl: Reise d. Tirol, etc., 1835, p. 96.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 712.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 515.

The male of this species may be readily recognized by the unusual dilation and flattening of segments 2-4 of the anterior tarsus; by the peculiar form of the middle metatarsus, the proximal half being flattened in one plane and the distal half flattened in another plane almost at right angles to the first; by the peculiar form of the process on the sixth sternite, which extends entirely across the sternite; and by the two very prominent carinae on the seventh sternite. On both male and female the fasciae on the tergite are continuous and sternites 2-5 are wholly yellow. On the female the sixth tergite and sternite are maculated and the sides of the propodeum and thorax, as well as the mesosternum, are almost entirely yellow.

This species is found in Spain, Portugal, and southern France. I have before me a male and a female determined by Mercet. The female bears the label "Los Molinos [Spain], G. Mercet," and the male the label "Madrid [Spain], G. Mercet."

## BEMBIX FORMOSANA Bischoff

*Bembix formosana* BISCHOFF, Deutsch. Ent. Zeitschr., Heft. 7, 1923, p. 714.

Of this species I have two specimens, a male and a female, both identified by Bischoff. The male bears the label "Formosa, Takao, 26.9.07, Sauter S. V.," and the female the label "S. Formosa, Takao, 7.8.1907, H. Sauter S. V." Judging by these labels and the data given in the original description of the species, I presume these specimens are from the number which Bischoff had before him when he described the species.

## BEMBIX KRIECHBAUMERI Handlirsch

Figures 113, 114

*Bembix krieschbaumeri* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 816.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 507.

I have before me a single male that I have referred to this species. It bears the label, "Togo, Frau Geh. Rat Döwitz G." The antenna is without spines or excavations; the posterior border of the middle femur is plain, being neither serrate nor dentate; there is a long, low, median, longitudinal carina on the second sternite; the sixth sternite lacks a true process, but there is a median, rounded elevation near the posterior end; the seventh tergite bears a prominent, median, longitudinal carina. A pair of short, narrow discal lines is present on the scutum; a fascia on posterior border of scutellum; a curved fascia on the propodeum; broad continuous fasciae on tergites 1-5, the

second including a pair of black spots; the sixth tergite bears a median spot. The pubescence is white and is well developed on the head, thorax, and propodeum. On the tergites the pubescence is fine and short on the anterior part of the abdomen, but increases in length posteriorly until on the sixth and seventh tergites it is quite long and conspicuous.

Handlirsch gives the distribution of this species as follows: "Neider-Guinea: Cap Lopez, Junk River, Gabun, Landana, Chinchoua und Vista an der Congomünding."

#### BEMBIX RAPTOR Smith

*Bembex raptor* SMITH, Cat. Hym. Brit. Mus., vol. 4, 1856, p. 326.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 901.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 511.—TURNER, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, p. 446.

I have before me a male and a female that, in Turner's "Key to the Australian Species of *Bembex*," run to this species. The male conforms quite closely to Smith's description of the species. The scutum bears a broken U-shaped discal mark, which shows only a trace of fuscous. The propodeum above is black. The black on the clypeus is confined to a narrow dorsal border. The antenna is without modifications. The sixth tergite is truncate at the apex and also plainly emarginate. This specimen bears the label, "Gordonvale, N. Q., J. F. Illingworth, Coll. Ex."

Of the female the prothorax, the sides of the mesothorax, metathorax, and propodeum are entirely yellow. There is a prominent U-shaped discal mark (decidedly rufous) on the scutum, prominent fascia on scutellum, metanotum, and propodeum. The fasciae on tergites 1-5 are broad, the first notched at the middle on the anterior border, the others at the middle on the posterior border, and all more or less bisinuate on the anterior border. The sixth tergite bears conspicuous lateral spots. Sternites 2-5 really bear broad fasciae, which are all but interrupted by large black spots that occupy the middle areas of the sternites. Sternite 6 bears lateral spots. The punctures on the black area of the second sternite are very large and not closely placed. The specimen bears the label, "N. W.-Australien, Carlshalton, E. Clement S. V." Turner reports this species as the most common one of central Australia.

#### BEMBIX BRULLEI Guerin

*Bembex brullei* GUERIN, Voyage de la Coquille, Zool., vol. 2, 1830, p. 253.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 835.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 503.

The male of this species, with its black thorax and propodeum, richly pubescent and with few or no maculations and with its shining

black abdomen and bright yellow fasciae confined to tergites 2-4, can scarcely be confused with any other American species. Except on the tergites, the maculations are pale. The fasciae on the tergites are usually all interrupted, but on some specimens that on the first tergite or those on the first and second are continuous. On one male there are small, yellow spots on the fifth tergite. The antenna is without structural modifications. The anterior metatarsus bears seven spines. The middle femora are smooth. The second sternite, although sometimes slightly carinate, is without a process; the sixth bears a small, median process that on some specimens is obsolete. The seventh is distinctly carinate on the midline.

The female appears under two forms: one has the fasciae on the tergites, the lateral spots on the sternites, and to a greater or less extent the legs also, bright yellow; while the other has the maculations on all parts of the body pale. With respect to the pattern of the maculations there is no essential difference between the two forms. Data derived from the specimens before me show that males and both forms of the female have been taken at the same place on the same date. The species seems to be confined to Chile.

## SPECIMENS EXAMINED

CHILE: Angol (1924, Det. Rohwer); Merimar (February, 1921); Santiago (February, 1921, A. Faz; 1923, Fr. Claude Joseph, Det. Herbst); Southern Part (M. J. Revera).

## BEMBIX PRUINOSA Fox

*Bembex pruinosa* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 361.

*Bembix pruinosa* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 104.

This is a well-marked species, one not likely to be confused with any other species thus far described from North America. On both sexes the maculations are white and relatively broad. The smooth middle femora, the absence of processes on the second and sixth sternites, and the reduction of the seventh sternite to a spine grooved on its ventral surface form a combination of characters that distinguish the male of this species. The female is distinguished by a black basal area on the clypeus (rarely obsolete); by fasciae (sometimes broken) on scutellum, metanotum and propodeum; and by the lack of any tendency in the fascia on the second tergite to inclose a pair of black spots.

## SPECIMENS EXAMINED

CALIFORNIA: Mount Shasta District.

CANADA: (C. F. Baker).

FLORIDA.

IOWA: Dubuque (August 25, 1872); Muscatine (August 8, 1889, Witter).

KANSAS: Riley County (September, Marlatt).

LOUISIANA: East Point (October 7, 1907, F. C. Bishopp).

NEW MEXICO: Albuquerque.

NEW YORK.

OHIO: Cedar Point (August, J. B. Parker).

OREGON.

TEXAS.

Fox reports this species also from Camden County, N. J.

**BEMBIX COMANTIS, new species**

Figure 222

*Male*.—Black: clypeus; labrum; base of mandibles; scape below; space between antennae; small spot on either side of anterior ocellus; anterior orbits, broad below, shortened above; narrow posterior orbits abbreviated above; lateral spot on prothorax joined with spot on tubercle; fascia on pronotum; short lateral line on scutum above base of wing; narrow fascia on posterior border of scutellum; very narrow fascia (almost obsolete) on posterior border of metanotum; pair of triangular spots on posterior surface of propodeum; small spot on lateral angle continuous with spot on side of propodeum; pair of spots on metapleura; small spot on mesopleura; broad, continuous fasciae on tergites 1-5; first with broad medial anterior emargination, deepest at midline; second, third, and fourth each with broad anterior emargination and slight median notch; fifth with shallow anterior biemargination; median spot on sixth tergite; tip of seventh; lateral spots on sternites 2-4, those on 2 and 3 connected by narrow apical lines; spot on anterior coxa; femora in part; tibiae, except line on first pair; and tarsi; *pale yellow*.

The pubescence is white, long and dense on head, thorax, propodeum, and first segment of abdomen. The mandibles bear only a single weak tooth. The flagellum is black above, testaceous below; it shows no special modifications that can serve as specific characters. The legs show no special developments. The second sternite bears a weakly developed median carina and the sixth is plain.

Length about 18 mm. Described from a single male from Rio de Janeiro, Brazil.

*Type* (male).—In the Carnegie Museum in Pittsburgh, Pa.

**BEMBIX BEUTENMULLERI Fox**

*Bembex beutenmulleri* Fox, Journ. N. Y. Ent. Soc., vol. 9, 1901, p. 83.

*Bembex obsoleta* HOWARD, Insect Book, 1904, pl. 4, fig. 36.

*Bembyx obsoleta* ROHWER, Proc. U. S. Nat. Mus., vol. 41, 1912, p. 467.

*Bembix beutenmulleri* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 105.

The male of this species resembles the male of the *pruinosa* in having the seventh sternite developed in the form of a grooved spine, but differs from that species in having the maculations greatly re-

duced and yellow in color, and in having a pair of small, approximated processes on the sixth sternite. This combination of secondary sexual characters distinguishes it from the male of *hinei* Parker, to which it has a superficial resemblance. The female of this species can be distinguished from the female of *hinei* by the character of the inner eye-margins, which on this species are distinctly divergent at the clypeus.

## SPECIMENS EXAMINED

CALIFORNIA: Los Angeles County (Coquillett).

**BEMBIX OCCIDENTALIS** Fox

*Bembex occidentalis* Fox, Proc. Acad. Cal. Sci., ser. 2, vol. 4, 1893, p. 10.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 868.—Fox Proc. Acad. Nat. Sci. Phila., 1895, p. 362.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 509.

*Bembex occidentalis* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 106.

Like the males of *pruinosa* and *beutenmulleri*, the male of this species has the seventh sternite developed in the form of a grooved spine, and like *beutenmulleri*, it has a pair of small, approximated processes on the sixth sternite. This species, in both sexes, is conspicuous for its extensive yellow maculations. The inner eye-margins on both sexes are divergent at the clypeus. The mandibles are slender, almost straight, and, even on the female, almost devoid of teeth on the inner margin.

## SPECIMENS EXAMINED

ARIZONA: Bill Williams Fork (August, F. H. Snow); Phoenix; Yuma (August 14, 1905, H. Brown).

CALIFORNIA.

LOWER CALIFORNIA: San Jose del Cabo.

NEW MEXICO: (C. F. Baker).

OREGON: Van Sickle Canyon (September 13, 1904, E. S. G. Titus).

**BEMBIX INFUMATA** Handlirsch

*Bembex infumata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 841.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 506.

*Bembex nubilipennis* CAMERON, Biol. Centr.-Amer., Hym., vol. 2, 1888-1890, p. 101 (misidentification).

The male of this species has the wings almost clear, while the wings of the female are distinctly infumated at the base. On both males and females the maculations are almost white. The second and sixth sternites of the male bear conspicuous processes and the sixth bears, in addition to the median process, a pair of well-developed lateral processes. Only three specimens of this species are found in the United States National Museum, a male and a female

bearing the label, "Guadalajara, VII, 27, Jal. Mex., McClendon," and a second male bearing only the label, "Mexico." Handlirsch based his description of the species on three females from Guajuato, Mexico.

**BEMBIX LITTORALIS** Turner

*Bembex littoralis* TURNER, Proc. Zool. Soc. Lond., 1910, p. 353.

I have before me a single male of this species determined by Turner and bearing the label, "Port Darwin, 12 '02." The clypeus, except a very narrow apical border, is black and the frons, except a small area between the antennae and a small spot on each side the anterior ocellus, is likewise black. The thorax, except the narrow posterior border of the pronotum and the tubercles, and the propodeum are entirely black. The maculations on the abdomen are limited to widely separated narrow fasciae on tergites 2-5 and lateral spots on sternites 2-4. The antennae are without structural modifications, the middle femora are smooth below, the second and sixth sternites bear processes, and the seventh tergite is triangular in outline and roundly pointed at the apex.

**BEMBIX INOPS** Handlirsch

*Bembex inops* HANDLIRSCH, Sitz. Akad. Wissensch, Wien, Math.-Nat. Cl., vol. 102, 1893, p. 833.

I have before me a male and a female of this species identified by Handlirsch and obtained by the United States National Museum as an exchange. They bear the label, "Ihering, Rio Grande, Brasil." As pointed out by Handlirsch, this species closely resembles *Bembix multipicta* Smith, of which species it may prove to be only a regional variety.

**BEMBIX MULTIPICTA** Smith

*Bembex multipicta* SMITH, Ann. Mag. Nat. Hist., vol. 12, 1873, p. 300.—HANDLIRSCH, Sitz. Akad. Wissensch, Wien, Math.-Nat. Cl., vol. 102, 1893, p. 831.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 509.

The fasciae on all tergites on both sexes are interrupted and that on the second incloses, more or less perfectly, a pair of black discal spots. On all specimens before me the scutum bears a pair of narrow discal lines, much reduced on one female. On the specimens from Mexico (two males and two females) the maculations on the thorax, propodeum, and abdomen are white. On a single female from Brazil the maculations are yellow, those on the tergites, the metanotum and dorsum of propodeum being pale yellow. The three females agree in having a more or less well developed dusky spot above on the apical segment of all tarsi. The black on the legs is much more extensive on the female from Brazil than on those from Mexico.

## SPECIMENS EXAMINED

BRAZIL: Diamantinas, Minas Geraes (November 14–18, 1919, Cornell University Expedition).

MEXICO: Atencingo (June 1, 1922, E. G. Smyth); San Rafael, Jicoltepec; Tuxpan, Jalisco (September 3, McClendon).

Handlirsch reports this species also from Guatemala; Demerara; Bogota; and Monta, Peru.

**BEMBIX FLAVOLATERA, new species**

Figures 94, 95

*Type* (male).—Black: labrum; mandibles, except tips; lower part of frons prolonged by a narrow line upward to meet a transverse series of three spots below anterior ocellus; broad anterior orbits shortened above; scape below; posterior orbits narrowed above; prothorax except narrow line in front of tubercles; broad lateral lines and pair of conspicuous discal lines on scutum; triangular lateral spots on scutellum; minute lateral spots on metanotum; sides of propodeum (but not lateral angles); large spot on metapleura; mesopleura almost entirely; fasciae on tergites 1–4 interrupted, those on 5 and 6 continuous; fascia on first tergite narrowest and most widely interrupted; fasciae on tergites 2, 3, and 4 broadly bisinuate on anterior dorsal border; fasciae on 5 and 6 acutely emarginate at midline on posterior border; second sternite, except narrow median line terminating on anterior border of tubercle and small pair of basal lateral black spots; third and fourth sternites almost wholly; broad fascia on fifth; apical fascia on sixth; coxae and trochanters more or less; femora, except black line on posterior surface of first pair and basal part of third; tibiae, except narrow line above on all; and tarsi; *yellow or white*. The white is limited to the apical fascia on the sixth sternite and to the fasciae on the tergites, of which those on tergites 1–3 show traces of yellow on their anterior margins, and particularly at the sides.

The flagellum is black above but light colored below, and while some of the segments show specialized areas, none of them are excavated or spinose. The terminal segment is only slightly curved and at the apex is roundly truncate. The second sternite bears a large, median tubercle or process, whose apex is curved posteriorly and sharply pointed. The sixth sternite bears a broad triangular raised area, whose apex on the median line can scarcely be called a point. The middle femora are plain. The anterior metatarsus bears seven spines, of which the basal one is small. The wings are hyaline and the second abscissa of the cubitella is lacking. The pubescence on head, thorax, propodeum, and base of abdomen is white and somewhat longer than is usually the case in this genus. The form of the



apex of the seventh tergite is peculiar, as is shown in Figure 95. The seventh sternite is narrowed and rounded at the apex and is carinate on the midline.

Length about 15 mm. This species is closely related to *B. littoralis* Turner, with which it agrees in the character of the genitalia, the antennae, the processes on the sternites, and the wings. It differs in the form of the seventh tergite and particularly in the extent of its maculations. It is also somewhat larger than *littoralis*. If it were not for the great difference in the extent and in the color of the maculations, I should be inclined to consider this individual only a variety of *littoralis*, which, according to Turner, is a variable species. Described from a single male bearing the label, "S. Australien, Hermannsburg, Finke River v. Leonhardt G."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX AGRESTIS, new species**

Figures 80-82

*Type* (male).—Black; labrum; clypeus; mandibles, except tips; short, broad anterior orbits; spot on either side anterior ocellus; space between antennae; scape below; posterior orbits not reaching vertex; narrow line on posterior border of pronotum; apical half of tubercle; minute lateral spots on posterior border of metanotum interrupted fascia on propodeum, broadest on posterior surface; continuous fasciae on tergites 1-6, the first narrow and somewhat sinuate, second inclosing a pair of dorsal black spots, third, fourth, and fifth broadly biemarginate on anterior dorsal border; median spot on seventh tergite extending to apex; lateral spots on sternites 2-6; median spot on second sternite; femora in varying degree; tibiae, except large spot below on all; and tarsi; *yellowish white*.

The flagellum is pale beneath and shows no special modifications, being neither spinose nor excavated. The middle femora are neither serrate nor dentate. The second sternite bears a median, laterally compressed tubercle whose sides are provided with numerous hairs as is the surface of the sternite generally. The sixth sternite bears a bluntly pointed, triangular median process and the seventh, whose apical border is emarginate at midline, bears a conspicuous median carina. The seventh tergite is truncate at the apex.

The *allotype* (female) resembles the type very closely in its maculations. The color is more yellowish than on the type. There is a spot on side of prothorax connected with spot on tubercle; a conspicuous spot on mesopleura; spot on side of propodeum. The sixth sternite is black. The sixth tergite is narrowed and rounded at the apex and the sides are only slightly sinuate. On its sides are found

a series of short, stout, spinelike hairs, among which are numerous long slender hairs, but neither extend to the apex.

The wings on this species are hyaline. The pubescence is normal, being most conspicuous on propodeum and base of first abdominal segment. There is a slight carina between the antennae and the anterior metatarsus is provided with six spines.

Length 16 mm. Described from one male and one female, each of which bears the label "Abessinien Eritrea bei Asamara, 2.III.13, Dr. Klass, S. G."

*Type*.—In Zoologisches Museum der Universitat. Berlin.

#### BEMBIX TEXANA Cresson

*Bembix texana* CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 219.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 830.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 514.

*Bembix texana* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 111.

On this species, both males and females, the maculations are white, sometimes slightly tinged yellowish. The wings are almost hyaline. The fascia on the second tergite incloses, sometimes completely, sometimes incompletely, a pair of black discal spots. On the clypeus of the female are invariably present a pair of black basal spots that vary in prominence on different specimens. The dorsum of the propodeum and the metanotum are without maculations and those on the scutellum and scutum are limited to small lateral spots. The middle femora of the male are smooth beneath.

#### SPECIMENS EXAMINED

ARKANSAS: Daleville (September 13, 1904, C. R. Jones).

FLORIDA: Crescent City (April 28, 1908, Van Duzee); Enterprise (May 16); Jacksonville (Ashmead); La belle (April 27, 1912); Lake Harney (May 3); Sanford (April 30, 1908, Van Duzee).

GEORGIA: Billy's Island, Okefenokee Swamp (June, 1912); Spring Creek (July 16-19, 1912); Tifton (May 6, 1896).

LOUISIANA: Fuierson (July 6, 1903, A. W. Merrill); Logansport (June 8, 1906, W. D. Pierce); New Orleans (July).

NEW MEXICO.

TEXAS: Dallas (June 2, 1907, W. W. Yothers); Rosser (June 28, 1905, C. R. Jones).

#### BEMBIX MELANASPIS Parker

*Bembix melanaspis* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 109.

Through its infumated wings and extensive yellow maculations this species resembles *nubilipennis*, but the two species are quite distinct. On the male of this species the flagellum is neither spinose nor dentate, the middle femora are smooth below, the sixth sternite lacks small lateral processes, and the genitalia are different from

those of *nubilipennis*. The female can readily be distinguished from the female of *nubilipennis* by the presence of black, more or less extensive, on the clypeus, which on *nubilipennis* is entirely yellow.

ARIZONA: (C. F. Baker).

CALIFORNIA: Bard (August 14, 1920, H. R. Reed); Los Angeles County (Coquillett); San Bernardino County (Coquillett).

#### BEMBIX TROGLODYTES Handlirsch

*Bembex troglodytes* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 829.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 515.

*Bembix troglodytes* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 108.

This species and the following one (*helianthopolis*) are closely related and are not likely to be confused with any other North American species. On both species the antennae of the males are plain, neither spinose nor excavated, the middle femora are smooth below, and the fasciae on the tergites, except that on the first, are continuous, and that on the second incloses, either perfectly or imperfectly, a pair of black discal spots. *Troglodytes* is much more slender in build than *spinolae* and its related species. The maculations are yellow.

Of the 11 specimens on which Handlirsch based his description of this species, 3 bore the label "Mexico." Apparently the locality from which the other specimens were obtained was unknown.

#### SPECIMENS EXAMINED

ARIZONA: (C. F. Baker).

NEW MEXICO: Las Cruces (August 27, Townsend).

TEXAS: Austin; Cypress Mills (Ashmead); Huntsville (C. Hartmann).

#### BEMBIX HELIANTHOPOLIS Parker

*Bembix helianthopolis* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 113.

This species is closely related to *troglodytes*, as was pointed out above. The male may be distinguished from the male of *troglodytes* by the lack of discal marks on the scutum, lack of maculations on the dorsum of the propodeum, and by the difference in the form of the genital stipes. The females of the two species are separated on the difference in their maculations: *helianthopolis* has the labrum (except sometimes the extreme lateral margins), the scape, and the sixth tergite black; *troglodytes* has these part yellow or conspicuously maculated with yellow.

#### SPECIMENS EXAMINED

KANSAS: Barber County (1916, R. H. Beames).

TEXAS: Victoria (July 15, 1915, J. D. Mitchell).

## BEMBIX BAHIAE, new species

## Figure 90

*Type* (male).—Black: labrum; mandibles, except tips; clypeus; scape below; area between antennae extended upward; pair of spots below anterior ocellus; broad anterior orbits shortened above; posterior orbits narrowed and shortened above; posterior border of pronotum; sides of prothorax, except large irregular spot in front of tubercle connected with black of pronotum; short, lateral lines above tegulae on scutum; pair of conspicuous lateral spots on scutellum; narrow, interrupted fasciae on metanotum; irregular spot on lateral angles of propodeum; metapleura; larger spot above and smaller spot below on mesopleura; broad fasciae on tergites 1–7; fasciae on tergites 1 and 5 narrowly interrupted at midline; fasciae on tergites 2–4 biemarginate on anterior dorsal border and deeply notched at midline on posterior border; lateral spots on sternites 2–5; greater part of femora; tibiae; and tarsi; *yellow or white*. Maculations on posterior border of pronotum and on scutellum and metanotum are white; elsewhere they are light yellow.

The clypeus is strongly and roundly arched and is scarcely carinate at the base. The frons is wide and between the antennae is weakly carinate. The inner eye-margins are parallel. The flagellum is black above, testaceous below, and none of its segments are spinose or excavated. The anterior metatarsus bears six spines and the middle femora are neither serrate nor dentate. The second sternite bears a small, thin, laterally compressed process and the sixth a narrow, triangular, sharply pointed process. The seventh sternite bears a median longitudinal carina that terminates at the apex of the sternite in a process much resembling that on the second sternite. The apex of the seventh tergite, is broadly triangular and roundly pointed. The pubescence is normal and the wings are hyaline.

Length 15 mm. Described from a single male (the type) bearing the label, "Bahia Blanca, Argentina."

*Type*.—Cat. No. 40846, U.S.N.M.

## BEMBIX DIVERSIPENNIS Smith

*Bembex diversipennis* SMITH, Ann. Mag. Nat. Hist., vol. 12, 1873, p. 297.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 102, 1893, p. 786.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 504.—TURNER, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 373.

I have before me two females that have been referred to this species. One bearing the label, "Togo Mangu, I. 02, G. Theierry S.," has been determined by Bischoff. This specimen bears well-developed fasciae

on the scutellum, metanotum, and dorsum of the propodeum, and well-developed fasciae on tergites 1-5, of which only that on tergite 5 is interrupted (narrowly); that on tergite 1 bears a single anterior emargination; that on 2 bears a pair of inclosed black discal spots; those on 3 and 4 are anteriorly biemarginate; and 6 is ferruginous. The other specimen bearing the label, "D. O. Afrika, Tabora, 7.08, Wintgens S. G.," differs from the first in having the clypeus yellowish; in having the ferruginous on the sixth tergite almost obliterated; and in having the fascia on the first tergite widely interrupted. The two specimens agree in having the antennae ferruginous, in having the clypeus and frons, except a black area about the anterior ocellus, predominantly ferruginous, in having the maculations of the prothorax ferruginous, in having the sides of the mesothorax, metathorax, and propodeum black, in having the lateral spots on the sternites reduced or wanting, and in having the basal half of the wings heavily infumated. The eyes are strongly divergent at the clypeus.

This species seems to be widely distributed over the eastern, central, and southern parts of Africa. Smith described the species from Angola. Handlirsch reports it from Massailand, Congo, Zanzibar, and Dar-Es-Salaam, German East Africa. Turner reports it from Nyassaland, Mashonaland, and Harar, Abyssinia.

#### BEMBIX MADECASSA Saussure

*Bembex madecassa* SAUSSURE, Mitth. Schweiz, Ent. Ges., vol. 8, 1891, p. 260.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 818.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 507.

I have of this species a single female determined by Kohl and bearing the label, "O Madagaskar, Tamatave, Voelzkow S., XI. 04." On this specimen the thorax and propodeum are entirely black; tergites 1 and 5 bear only vestiges of lateral spots; tergites 2, 3, and 4 bear narrow sinuate fasciae interrupted at midline; the sixth tergite and the sternites are entirely black. This species seems to be confined to Madagascar.

#### BEMBIX VARIABILIS Smith

*Bembex variabilis* SMITH, Cat. Hym. Ins. Brit. Mus., vol. 4, 1856, p. 325.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 846.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 515.—TURNER, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, p. 446.

I have before me a single female that agrees quite closely with Smith's description. It bears the label, "Cairns, N. Q., J. F. Illingworth, Collector." This species seems to be widely distributed over Australia.

## BEMBIX ATRIFRONS Smith

*Bembex atrifrons* SMITH, Cat. Hym. Ins. Brit. Mus., vol. 4, 1856, p. 327.

*Bembex flavilabris* SMITH, Ann. Mag. Nat. Hist., ser. 4, vol. 12, 1873, p. 299.

*Bembex atrifrons* TURNER, Proc. Zool. Soc. London, 1910, p. 353; Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, p. 441.

I have at hand a single female that I have referred to this species. It differs slightly from Smith's description: the extreme ventral margin of the clypeus and its extreme ventro-lateral angles are maculated; shortened, narrow anterior orbits are present; there are lateral spots on the prothorax united with the yellow on the tubercles; and there are small, round lateral spots on the scutellum. The metanotum, propodeum, mesopleura, metapleura, the sixth tergite, and all sternites are black. The specimen bears the label, "Adelaide, Behr S." Turner reports this species from Yallingup and Busselton, West Australia, and also from South Perth.

## BEMBIX NUBILOSA, new species

*Type* (female).—Black: labrum; mandibles, except tips; clypeus, except pair of small basal spots, of which one is almost obsolete; area between antennae; small vertical stripe below anterior ocellus; scape below; broad anterior orbits, shortened and deflected inward above; narrow posterior orbits, shortened above; tubercles and narrow posterior margin of pronotum; spot on tegula; small lateral spots on scutellum; spot on posterior-lateral angles of propodeum; short, narrow line on mesopleura; broad fasciae on tergites 1–5, first interrupted medially, second and third broadly and deeply biemarginate on anterior border and also widely emarginate at middle on posterior border, fourth and fifth similar to second and third, but with emarginations less well developed; lateral spots on sternites 2–4; femora apically; tibiae, except line below on first and second pairs; and tarsi; *yellow or creamy white*.

The flagellum is black above, yellowish below, especially toward the apex. The wings are heavily infumated, the hind wings throughout and the basal three-fourths of the front wings. The pubescence is white, dense, and comparatively short on head, thorax, and propodeum. On the abdomen it is shorter but unusually well developed, especially on the tergites of the last three segments. The frons is very wide and the inner eye-margins parallel. The sixth tergite is coarsely punctate, even to the apex, giving the surface a roughened appearance. The second sternite is finely punctured with numerous larger punctures among the fine ones; on the midline there is an evident, though not prominent, carina. The fasciae on the tergites are a pale creamy, almost white, color, while the legs are orange yellow.

The paratype differs from the type in the absence of any black on the clypeus; in the presence of a yellow spot on the side of the prothorax and another on the metapleura; and in the fact that the lateral spots on the scutellum form a curved fascia interrupted medially. In Handlirsch's table this species runs to *infumata*, but it differs from that species in the greater infumation of the wings and in having all the fasciae on the tergites, except that on the first, continuous.

Length 17 mm. Described from two females from San Luis Potosi, Mexico.

*Type*.—In the collection of Massachusetts Agricultural College, Amherst, Mass.

**BEMBIX LUZONENSIS, new species**

*Type* (female).—Black: labrum; mandibles, except tips; clypeus, except broad, black basal border; line on scape below; lower border of frons limited between the antennae by a black spot extending from the insertion of one to the insertion of the other and prolonged upward by a very narrow median line dividing the yellow above the antennae along the midline; spot below anterior ocellus connected with yellow of frons below; short anterior orbits; posterior orbits very narrow above; narrow posterior border of pronotum; side of prothorax, except spot on tubercle; small spot on lateral angle of propodeum; broad, vertical anterior spot on side of propodeum; two elongated spots on metapleura; oval posterior spot and large, irregular anterior spot on mesopleura; widely separated lateral spots on first tergite; continuous fascia on second tergite with wide posterior dorsal emargination that is extended into the fascia on right and left; continuous fascia on third tergite with pair of deep, rounded, anterior, dorsal emarginations and broad, shallow, median posterior emargination; continuous fascia on tergite 4 similar to that on 3; fascia on tergite 5 interrupted at dorsal midline; small lateral spots on sternites 2-3; anterior coxæ below; line on anterior and posterior borders of all femora; all tibiae above; and anterior tarsi above; *pale creamy yellow*.

The flagellum is black. The inner eye-margins are very slightly divergent at the clypeus. The pubescence is very short and inconspicuous. The wings are lightly and uniformly infumated and the second abscissa of both radiella and cubitella is present. The anterior metatarsus is provided with only five spines. The disk of the second sternite is smooth and shining and bears scattered, coarse punctures. The sixth sternite is feebly carinate on midline and is densely covered with very fine punctures, among which are scattered many coarse ones and consequently is covered with a fine pubescence,

among which are present many coarser hairs. The sixth tergite, which is bluntly triangular and broadly rounded at the apex, is finely punctate and covered with a fine, dense, closely appressed pubescence, among which near the lateral margins are numerous coarser and longer hairs. The extreme apical margin is smooth and shining.

Length 20 mm. Described from a single female bearing the label, "Philippinen, Insel Luzon, Rolle V."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX NUPERA, new species**

*Type* (female).—Black: labrum; mandibles except tips; clypeus in part; broad anterior orbits; pair of spots on frons below level of anterior ocellus; posterior orbits broad below and each interrupted at vertex; posterior broader of pronotum enclosing a pair of elongated black lateral spots; sides of prothorax; lateral lines, pair of transverse posterior spots and vestiges of pair of longitudinal discal lines on scutum; fascia on posterior border of scutellum; fascia on metanotum; vestiges of fascia on propodeum; large spot on side of propodeum (not reaching lateral angle); line on anterior margin of metapleura; two spots on mesopleura; conspicuous, continuous fasciae on tergites 1–5, that on first slightly narrowed medially, those on 2–5 bisinuate on anterior border the sinuations on tergite 2 widely separated, the width of the separation decreasing from two to five, those on 2–4 acutely emarginate at midline on posterior border; apex of tergite 6; fasciae on posterior border of sternites 2–5; tibiae in part; and tarsi; a light and variable shade of yellow. Clypeus in part; scape; flagellum below; legs, except tibiae in part and tarsi; large median spot on sternite 2 almost interrupting the fascia; median transverse area between the black basal border and the posterior fascia practically interrupting the fascia on sternites 3–5; sixth sternite entirely; and basal part of the maculation on tergite 6; ferruginous.

The flagellum is dusky above, being darkest toward the apex. The ferruginous is most in evidence on the basal segments of the legs and on the sternites. The clypeus on its basal half is strongly carinate and its color is a mingling of light yellow and ferruginous with a basal spot on either side the carina that is almost black. The basal portion on either side the carina is covered with short, dense, silvery pubescence. The frons is wide and carinate between the antennae and the inner eye-margins are slightly divergent at the clypeus. The anterior metatarsus is provided with seven spines. The wings are hyaline and the second abscissa of the cubitella is lacking. The disk of the second sternite is smooth and shining and



except on the midline bears numerous coarse punctures, while those at the sides are much finer. The sixth tergite is broadly rounded at the apex and the sixth sternite is noncarinate. The pubescence, which is short and white, is almost lacking on dorsum of thorax and propodeum.

Length 20 mm. Described from a single female bearing the label, "Witu Lamu, G. Denhardt G."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX CAPENSIS** Lepeletier

*Bembex capensis* LEPELETIER, Hist. Nat. Ins. Hym., vol. 3, p. 273.—HANDLIIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 853.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 503.

To this species I have referred a single female bearing the label, "D. S. W. Afrika, Lindt S." The clypeus is covered with fine, silvery pubescence. In other respects it conforms very closely to the description of the species as given by Handlirsch, who reports it from South Africa (Transvaal and Capeland).

**BEMBIX GRACILENS**, new species

Figure 109

*Type* (female).—Black: narrow fascia on posterior dorsal border of pronotum, connecting large, lateral spots; tubercle and narrow line running downward from it on side of prothorax; narrow fascia on posterior border of scutellum; fascia on metanotum; interrupted fascia on dorsum of propodeum; lateral angles of propodeum; broad fasciae on tergites 1-5, first greatly narrowed (almost interrupted) at dorsal midline, second inclosing pair of elliptical, dorsal spots, third strongly and fourth weakly biemarginate on anterior dorsal border; small lateral spots on sternites 2-5; *yellow*. Clypeus, antennae, except tips above; narrow line between antennae and pair of spots above them; three spots on frons at level of anterior ocellus; broad anterior orbits deflected inward from eye-margins above anterior ocellus; posterior orbits; apex of sixth tergite; apex of sixth sternite; narrow apical lines joining yellow lateral spots on sternites 2-5; legs for the most part; *ferruginous*. The clypeus and mandibles, as well as the lower part of the posterior orbits, are more yellow than ferruginous. The tibiae and tarsi also show this mingling of yellow and ferruginous and the femora at the base are marked with black.

The basal half of the wings is strongly infumated, whereas the apical part is hyaline. The pubescence is white and comparatively abundant on head, sides of thorax, and on the propodeum. On the

clypeus it is short, dense, and silvery. The frons is wide, weakly carinate between the antennae, and the inner eye-margins are approximately parallel. The anterior metatarsus bears six spines. The disk of the second sternite is shining and bears scattered, coarse punctures. The apical part of the sixth tergite is plainly carinate at midline.

In Handlirsch's table this species runs, although not accurately, to *B. tricolor* Dahl. It differs from that species in having no black on the clypeus and in the absence of any maculations on the sides of the mesothorax, metathorax, and propodeum. Furthermore, the wings of this species are strongly infumated at the base, while the apical portion is hyaline. The insect is decidedly slender in form and the sixth tergite is broadly rounded at the apex.

Length 17 mm. Described from a single female bearing the label, "D. S. W-Afrika, 1901, Lübbert S. V."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX LIVENTIS, new species**

*Type* (female).—Black: labrum; mandibles, except tips; clypeus, except pair of large, dark basal areas; scape below; lower part of frons; pair of rounded spots below anterior ocellus; broad, anterior orbits barely reaching the level of anterior ocellus; broad, posterior orbits, each greatly narrowed and interrupted at vertex; prothorax, except anterior transverse dorsal spot and dusky line in front of tubercles; broad, lateral lines and pair of very narrow, obscure, longitudinal, discal lines on scutum; narrow fascia on posterior border of scutellum; very narrow fascia on metanotum; shortened fascia on propodeum interrupted at midline; almost the entire side of propodeum (but not the lateral angles); anterior portion of metapleura; mesopleura almost wholly; fascia on first tergite narrow and interrupted at dorsal midline; fascia on second tergite broader, interrupted at midline and bisinuate on anterior dorsal border; fascia on third similar to that on second; fascia on fourth similar to those on second and third, but continuous; fascia on fifth broken into a central and lateral spots; apical portion of sixth; small posterior lateral spots on sternites 2-5; apical margin of sternite 6; legs, except more or less of the coxae and trochanters, dusky spot below on middle femora, and dark one above and one below on posterior femora; *yellow*, which varies in shade on different parts of the body.

The maculations on the dorsal part of the thorax and on the abdomen are decidedly pale, whereas those on the sides of the thorax and on the legs show a tendency toward ferruginous. The flagellum

is black above, but of a light shade of ferruginous below. The inner eye-margins are a trifle wider apart at the clypeus than at the vertex. The frons is broad and between the antennae strongly carinate. The basal half of the clypeus on the midline is also strongly carinate, while the median apical portion is somewhat flattened. Except the ridge of the carina and the apical flattened part, the clypeus is covered with fine, silvery pubescence. The anterior metatarsus bears seven spines. The disk of the second sternite is shining and on either side the midline are scattered coarse punctures, among which are numerous fine punctures. Only a small, median anterior area is free from punctures. The sixth sternite is slightly carinate on midline and is closely covered with punctures, in which coarse and fine are intermingled. The sixth tergite is broadly rounded at the apex. The wings are clear and the second abscissa of both radiella and cubitella is present, although the latter is much reduced. The pubescence on thorax, propodeum, and abdomen is of normal character. The dorsal surface of the abdomen, when light strikes it at the proper angle, shows a beautiful, bluish iridescence, a character not common among species of this genus.

Length, 20 mm. Described from a single female bearing the label, "D. Ostafrika, Mikidani, II.-IV. 1911, H. Grote S. G."

*Type*.—In the Zoologisches Museum der Universität, Berlin.

**BEMBIX HEXASPILA, new species**

*Type* (female).—Black: labrum; mandibles, except tips; space between antennae continued broadly upward to join, below anterior ocellus, a transverse band that unites with the anterior orbits; broad anterior orbits almost interrupted below junction with transverse band, but above it deflected inward to join the posterior orbits on the vertex; scape, except black line above; posterior orbits broad below; pronotum; broad lateral lines and broad U-shaped discal mark on scutum; broad continuous fascia on scutellum; metanotum; broad, curved fascia on propodeum covering most of its dorsal and posterior surfaces; lateral angles and sides of propodeum; metapleura; mesopleura; mesosternum, except pair of black spots anterior to each middle coxa; very broad, continuous fasciae on tergites 1-5, all acutely emarginate at midline on posterior border, the first with a pair of rounded dorsal spots, of which one is not completely inclosed, second and third each with a pair of elliptical dorsal spots, and fourth and fifth bisinuate on anterior dorsal border; first sternite; second sternite, except large central black spot and pair of small anterior lateral black spots; third sternite, except large median and pair of anterior lateral black spots; fascia on fourth resembling

the maculation on third, but reduced in extent; posterior lateral spots on fifth; extreme posterior lateral edges of sixth; legs, except black stripe above on all femora, small black spot below on anterior tibiae and one above on posterior tibiae, and a varying degree of black on coxae and trochanters; *yellow*. The fasciae on the tergites show two colors, the posterior portion of each fascia being much lighter (more nearly white) than the anterior portion. The first tergite, in addition to the broad dorsal fascia found on its curved surface, bears a conspicuous fascia across its anterior vertical surface. The U-shaped discal mark on the scutum shows a tinge of rufous.

The flagellum above, except the terminal segment, is black; this segment and the lower surface of the flagellum are ferruginous. The clypeus and the lower part of the anterior orbits are covered with a silvery pubescence. Elsewhere the pubescence is short and white and presents the normal appearance. The frons between the antennae and the base of the clypeus at midline are only slightly carinate. The frons is broad and the inner eye-margins are slightly wider apart at the vertex than at the clypeus. One anterior metatarsus bears seven and the other eight spines, of which the two at the apex of each differ greatly from one another in length. The disk of the second sternite is shining and bears only coarse punctures. The apex of the sixth tergite is broadly rounded and on the midline is devoid of punctures. The sixth sternite is noncarinate and is covered with coarse setigerous punctures that become smaller near the basal lateral margin. The first intercubitus vein is almost straight and the second abscissa of the cubitella is lacking.

Length 13 mm. Described from a single specimen bearing the label, "Pusa, Coll. Bingham." It also bears the label, "*Bembex orientalis* Hdl.," but by whom the determination was made is not shown.

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

#### BEMBIX BORNEANA Cameron

*Bembex borneana* CAMERON, Proc. Zool. Soc. Lond., vol. 2, 1901, p. 26.

In the collection of the United States National Museum, bearing the label, "Tambak," is a single female that has been identified as *Bembix borneana* Cameron, but by whom the identification was made is unknown. Cameron based his description of this species on the male alone, the female at that time apparently being unknown to him. It is possible that this specimen was determined by Cameron himself some time after his description of the species and sent to Ashmead in an exchange, but of this we have no proof. If a description of the female of this species has been published, I have not seen it.

This female is smaller than the male Cameron described, being less than 20 mm. in length. The anterior metatarsus is broader and flatter than usual in this genus, thus agreeing with the male from which the species was described. In this respect it resembles *Bembix palmata* Smith, but the dilation of the anterior metatarsus is less pronounced on this specimen than on *palmata*. The clypeus bears a pair of large, basal, black spots; the scutellum and metanotum each bears a narrow, interrupted fascia, and the scutum bears a broken U-shaped discal mark. The propodeum bears a prominent curved fascia, and the sides of the thorax and propodeum are yellow, except a black spot below the tegula on the mesopleura, another in front and above the middle coxa, and a vertical black stripe on the propodeum. The fasciae on tergites 1-5 are narrow, the first interrupted, the second inclosing a pair of black discal spots, and the third, fourth, and fifth biemarginate on anterior border. The yellow on the sternites is limited to small lateral spots on 2 and 3. The anterior metatarsus is provided with only five spines.

#### BEMBIX PALMATA Smith

*Bembex palmata* SMITH, Cat. Hym. Ins. Brit. Mus., vol. 4, 1856, p. 325.

*Bembex tridentifera* SMITH, Ann. Mag. Nat. Hist., ser. 4, vol. 12, 1873, p. 298.

*Bambex palmata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl.

vol. 102, 1893, p. 751.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 511.—TURNER, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, p. 438.

I have at hand a single female that I have referred to this species. On the lateral border of the clypeus running to the ventral margin is a short but deep depression, causing the clypeus at this point, when viewed from in front, to appear to overhang the base of the mandibles. With regard to the maculations, this specimen agrees with Handlirsch's description of the species. It is from Australia and bears the label, "N. Queensland, Coll. Bingham."

#### BEMBIX SPIRITALIS, new species

*Type* (female).—Black: labrum, mandibles, except tips; clypeus, except large medial black spot; scape below; frons between antennae; broad but shortened anterior orbits; three spots on frons below the level of anterior ocellus; pair of spots on vertex not connected with orbits; broad posterior orbits, above extending inward and downward on the occiput; prothorax almost wholly; broad lateral lines and U-shaped discal mark on scutum; broad fascia on posterior border of scutellum; fascia on metanotum; broad, curved fascia on propodeum; mesopleura, metapleura, and side of propodeum almost wholly; broad, continuous fasciae on tergites 1-5, occupying the anterior part of the tergites and leaving an evident posterior black

border; fasciae on tergites 1-3 each inclosing a pair of black discal spots, and those on 4-5 deeply emarginate on anterior border; small lateral spots on sternites 2-4; femora largely; tibiae, except spot above on first pair and spot below on hind pair; and tarsi; *creamy yellow*.

The fasciae on the tergites are lighter in shade than the maculations on the body, some of which take on an orange shade of yellow. The mandibles are long and slender and are unidentate. The proboscis (maxillae) is longer than is normal in this genus and when at rest can not be completely concealed beneath the labrum. The clypeus is unusually prominent and basally is distinctly carinate on the median line. Apically the clypeus is somewhat flattened medially and its apical margin is strongly arcuate in form. The frons is very broad, forming more than one-third of the total width of the head. The flagella are missing. The anterior metatarsus is provided with six spines. The yellowish pubescence is long and unusually well developed on the head, thorax, and propodeum. The sixth tergite is narrowed and roundly pointed at the apex.

Length 15 mm. Described from a single female, the type, bearing the label, "Espirito Santo, Brasil, H. Rolle, Berlin W."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

#### BEMBIX MELANCHOLICA Smith

*Bembex melancholica* SMITH, Cat. Hym. Ins. Brit. Mus., vol. 4, 1856, p. 328.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 783.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 508.

In the collection of the United States National Museum there is a single female of this species received in exchange, but by whom identified is not known. It bears the label, "W. Sumatra, Pedang, 23.XII. 08, Schoede, S. G." In all respects, except that of the color of the maculations, this specimen agrees quite closely with Smith's description of the species. Instead of being "livid yellow," as Smith describes the maculations, they are on this specimen very pale, hardly to be regarded as yellow. The abdomen, however, shows that blue-black iridescent ground color that Smith reports for this species. In addition to Sumatra, Handlirsch lists the points of distribution: Borneo, Malacca, Singapore, Madras, Salvatti, and Morty Islands.

#### BEMBIX BORREI Handlirsch

*Bembex borrei* HANDERLISCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 866.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 502.

In the United States National Museum are two females that I have referred to in this species. They bear the label, "Culasi Panay, P. I., June, 1918, McGregor." A description follows:

Black: labrum; mandibles except tips; clypeus in part; minute spot between antennae; pair of spots at their insertion; minute spot below anterior ocellus; spot on scape below; anterior orbits, almost obsolete; posterior orbits narrowed and shortened above; fascia on pronotum continued on tubercles and sides of prothorax; pair of lateral spots on side of prothorax; lateral lines and U-shaped discal mark interrupted at midline on scutum; fascia on posterior border of scutellum; fascia on metanotum; curved fascia on propodeum extended on posterior surface and narrowly interrupted; lateral angles and side (in part) of propodeum; vertical spot on metapleura; triangular spot on mesopleura; continuous fasciae on tergites 1-5, first with pair of rounded dorsal and pair of pointed lateral anterior emarginations, second and third narrowed at midline and each enclosing pair of discal spots, fourth and fifth broadly biemarginate on anterior border; pair of lateral spots on sternites 2-5, those on second and third extended and attenuated medially; femora, except line on both anterior and posterior surface; tibiae, except line on anterior and posterior surface of first and second pairs and on posterior surface of third pair; and tarsi; *yellow*.

The markings on the thorax and abdomen are bright lemon yellow; those on the legs are darker in shade; the markings on the head are very pale. The flagellum is black and the wings are hyaline. The pubescence is light in color and normal in development. The sixth tergite is roundly pointed and is uniformly and rather coarsely punctate, except at the apex and on the midline of the posterior half of the tergite, which are devoid of punctures. The frons is relatively broader than usual and the inner eye-margins are parallel. The black basal border of the clypeus on one specimen is expanded at the midline so as to reach almost to the ventral border of the sclerite; on the other specimen the black is confined to a pair of irregular basal spots.

**BEMBIX LONGIPENNIS, new species**

*Type (female).*—Black: labrum; clypeus, except a pair of narrow lines paralleling the basal margin; mandibles, except tips; frons to level of anterior ocellus, except pair of large black spots; scape, except small apical spot above; anterior orbits deflected inward at anterior ocellus and reaching almost to vertex; posterior orbits broad below; prothorax, except three anterior black dorsal spots; broad lateral lines and long, narrow discal lines on scutum; fascia on posterior border of scutellum; fascia on posterior border of metanotum; curved fascia on dorsum of propodeum broadly extended on posterior surface; lateral angles and sides of propodeum almost wholly; metapleura; mesopleura almost completely; broad

fascia on first tergite narrowed and narrowly interrupted at mid-dorsal line; broad fasciae on tergites 2-5, all slightly sinuate on posterior dorsal border, that on 2 inclosing pair of large, elliptical spots and acutely emarginate at median anterior border, that on 3 biemarginate, and those on 4 and 5 bisinuate on anterior border; apex of sixth tergite; pair of small anterior spots on sternite 2; lateral spots connected by very narrow apical lines on sternites 1-5, each apical line apparently interrupted at mid-ventral line by a dark ferruginous spot; legs, except more or less of basal joints, line above on all femora, narrow line below on tibiae, and small spot or line at base above on tibiae; *yellow*.

The flagellum below is ferruginous; above it is quite dark but shades to ferruginous at the apex. The anterior metatarsus is provided with six spines, of which the basal one is quite small. The wings are hyaline and very long, reaching the end of the abdomen. The second abscissa of both radiella and cubitella is present. The frons between the antennae and the adjacent basal part of the clypeus are distinctly carinate. The sixth tergite is coarsely punctate and the apical part is distinctly ferruginous. The sixth sternite is distinctly carinate on the midline and, like the sixth tergite, its apex is marked with ferruginous. The disk of the second sternite is smooth and shining and bears numerous, scattered, coarse punctures.

The paratype (female) differs from the type in having the fascia on the scutellum interrupted at midline; in having the fascia on the first tergite reduced to lateral spots; in having the inclosed spots on the fascia on the second tergite reduced to anterior emarginations; and in having the fascia on tergite 5 narrowly interrupted at the mid-dorsal line. The ferruginous markings on the sixth abdominal segment are present, but less well developed than on the type.

Length 22 mm. Described from two females, each of which bears the label, "Nyassa-See, Langenburg, 9-19-VIII, 98, Fütteborn S."

*Type*.—In the Zoologisches Museum der Universität, Berlin.

#### BEMBIX LATIFASCIATA Turner

*Bembix latifasciata* TURNER, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 57; Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, p. 443.

I have at hand a single female that I have referred to this species. The second sternite (third and fourth also) is entirely yellow; the sixth tergite bears lateral spots; the fasciae on the tergites are broad and only the first is narrowly interrupted. These fasciae on the tergites have their anterior borders yellow and the posterior part white. The scutellum, metanotum, and propodeum each bears a prominent fascia; there is a prominent U-shaped discal mark on the scutum; and there is a pair of black spots on the clypeus. The



specimen bears the label, "S. Australien, Hermannsburg, Finke River, v. Leonhardi G." Turner reports the species also from West Australia.

**BEMBIX LAETA, new species**

Figure 115

*Type* (female).—Black: labrum; mandibles, except tips; clypeus, except pair of black medial spots and pair of very narrow lines at base; lower part of frons connected by vertical line with spot below anterior ocellus; scape below; broad anterior orbits deflected inward from the eye-margin at the vertex; posterior orbits; prothorax, except narrow line in front of tubercles; broad lateral lines and broad unbroken U-shaped discal mark on scutum; broad fascia on posterior border of scutellum; fascia on metanotum; curved fascia on dorsum of propodeum broadly extended on median posterior surface; lateral angles and sides of propodeum; metapleura; greater part of mesopleura; broad fascia on tergite 1, abruptly narrowed and interrupted at dorsal midline; continuous fasciae on tergites 2-4, that on 2 inclosing pair of narrow, elliptical, black spots those on three and four biemarginate on anterior border and all three acutely emarginate at midline on posterior border; fascia on fifth tergite narrowed and interrupted at dorsal midline; lateral spots on tergite 6; lateral spots connected by apical lines on sternites 2-5; coxae and trochanters more or less; femora except spot below and narrow line above; tibiae; and tarsi; *yellow*. The legs of the U-shaped discal mark on the scutum are decidedly rufous in color.

The flagellum is slender, black above, except the terminal segment, which is fuscous, and yellowish below, shading to fuscous at the apex. The frons is broad and the inner eye-margins are approximately parallel. The wings are hyaline and the second abscissa of both the radiella and the cubitella is present. The anterior metatarsus is provided with six spines. The pubescence is light in color, short, and relatively dense on head, thorax, propodeum and base of abdomen. The disk of the second sternite is smooth and shining and bears scattered, coarse punctures. The sixth tergite is narrow and roundly pointed at the apex.

Length 15 mm. Described from a single female bearing the label, "D. O. Afrika, 18, 12, 10, Makonde-Hochld, Grote S. G."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

**BEMBIX BELLATRIX, new species**

Figure 96

*Type* (female).—Black: labrum; mandibles, except tips; scape below; spot between antennae; broad anterior orbits, shortened above,

deflected away from the eye-margins and narrowed; posterior orbits broad below; narrow posterior border of pronotum; sides of prothorax, except irregular black spot in front of tubercles; short lateral lines above base of wings and pair of narrow longitudinal discal lines on scutum; narrow fascia on posterior border of scutellum; narrow fascia on posterior border of metanotum; curved fascia on propodeum, broadened and interrupted at midline on posterior surface; lateral angle continuous with large spot on side of propodeum; large spot on metapleura; smaller spot on mesopleura; broad, continuous fasciae on tergites 1-5; fascia on first tergite with a median anterior emargination extended to right and left, thus producing a large, flattened, heart-shaped area in the fascia; second fasciae with a wider but shallower median anterior emargination partly inclosed; third and fourth fasciae each also with a shallow median anterior emargination; large apical heart-shaped spot on sixth tergite; lateral spots connected by narrow apical lines on sternites 2-5; spot on anterior coxa; femora in part; tibiae, except line above and one below on anterior pair and line below on middle pair; and tarsi; *pale tinged with light creamy yellow.*

The flagellum is black, paler below. The frons is broad and the inner eye-margins are parallel. The dorsal border of the clypeus at the midline is extended upward between the antenna, forming an angle whose apex is above a line marking the lower level of the insertion of the antennae on the frons (fig. 96). Although this modification in the form of the dorsal border of the clypeus is not unique with this species, it is more pronounced than on any species I have so far seen. The frons between the antennae and the dorsal part of the clypeus are distinctly carinate. The anterior matatarsus bears six spines. The wings are hyaline. The sixth tergite is triangular in outline, rather narrow, and roundly pointed at the apex. The second sternite is uniformly, closely, and finely punctate throughout its entire surface, with here and there a few somewhat larger punctures scattered over it.

With the type I have associated as a paratype a single female that may prove to be a female of another species. It is more slender than the type; this is particularly evident with regard to the thorax. The color of the maculations on the abdomen is distinctly greenish yellow. In other respects, including the form of the clypeus and the punctation of the second sternite, it agrees so closely with the type that under the circumstances I am forced to regard it as a variant of this species.

Length about 17 mm. Described from two females, of which the type bears the label, "Brasilien, St. Cath. Joinville, Schmalz S. V.," and the paratype, the labels, "Brasilien, Freir. S." and "3738 Bras."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

## BEMBIX GENEROSA, new species

Figures 107, 108

*Type* (female).—Black: clypeus; labrum; mandibles, except tips; frons below level of anterior ocellus, except pair of black spots; scape, except small spot above; broad anterior orbits; broad posterior orbits united above; prothorax entirely; broad lateral lines and broad U-shaped discal mark on scutum; broad posterior fascia on scutellum; metanotum; broad, curved fascia on propodeum; posterior surface, lateral angles and sides of propodeum; sides and venter of mesothorax and metathorax entirely; continuous fasciae on tergites 1–6, the first with deep, round, median, anterior emargination, almost inclosed, and pair of shallow, posterior, dorsal emarginations, second inclosing pair of elliptical, dorsal, black spots, third, fourth, and fifth biemarginate on anterior border, sixth with anterior, lateral emarginations; second sternite, except large median and small transverse posterior spot; lateral spots on sternites 3–5 connected by broad, apical bands; legs, except small black spot above on posterior femora; *yellow*.

The flagellum, which changes to fuscous at the apex, is black above and yellowish below. The wings are hyaline and the second abscissa of the cubitella is lacking. The anterior metatarsus bears eight spines. The disk of the second sternite is densely covered with minute punctures and is also covered with a very fine, short pubescence. The pubescence elsewhere on the body is unusually short and sparse, in fact, almost lacking. The sixth tergite bears a small pygidial area, which is set off by lateral ridges and whose surface is coarsely punctate and shows an evident median carina. The sixth sternite is densely and finely punctate with coarse punctures scattered over its surface, and is accordingly provided with, fine, dense pubescence, in which are scattered many relatively longer, coarser hairs.

This species stands close to *B. chlorotica* Handlirsch, from which it differs in its slightly smaller size and in the character of its maculations.

Length 16 mm. Described from a single specimen bearing the label, "S. Somala Karo Lola 6. 5. 01, B. v. Erlanger."

*Type*.—In the Zoologisches Museum der Universität, Berlin.

## BEMBIX PIRAPORAE, new species

*Type* (female).—Black: labrum; mandibles, except tips; clypeus; lower part of frons produced upward in a stripe on the midline to join a large spot below anterior ocellus; a smaller spot on either side this large central spot; broad anterior orbits reaching vertex, where they are deflected inward away from eye-margins; scape below;

posterior orbits; prothorax, except black area above and dusky spot in front of tubercles; conspicuous lateral lines and broken U-shaped discal mark on scutum; fascia on scutellum, narrowed toward the midline and rather widely interrupted; fascia on metanotum; curved fascia on propodeum, interrupted at midline on posterior surface; lateral angles and almost the entire sides of propodeum; metapleura and mesopleura entirely, except narrow black lines along the sutures; fasciae on tergites 1-5, all interrupted at mid-dorsal line, except the second; fascia on second tergite biemarginate on anterior border, the emarginations almost enclosed; fasciae on tergites 3-5 also more or less conspicuously biemarginate on anterior dorsal border; pair of basal lateral spots on sixth tergite; sternites 1-5, except small median and pair of small, anterior lateral spots on second, and pair of anterior emarginations on fifth; legs, except more or less black at articulations of coxae and trochanters, black on femora above, and black on basal part of tibiae above; *yellow*.

The flagellum is black with a narrow, yellowish line below, becoming testaceous toward the apex. The longitudinal lines of the broken U-shaped discal mark on the scutum are tinged with reddish. The wings are hyaline. The pubescence is relatively well developed, white, and longer and more conspicuous on the head than elsewhere. The frons is wide, forming almost half of the width of the front aspect of the head. The inner eye-margins are parallel. The anterior metatarsus bears six spines. On the sixth tergite there are evident, though weakly developed, lateral ridges and the punctures on the apical half of the tergite are coarse.

The paratype differs from the type only in having an anterior, median, black area on sternites 3 and 4 and in having the lateral ridges on the sixth tergite almost obsolete.

Length 13 mm. Described from two females (type and paratype) bearing the label, "Pirapora, Minas Geraes, Brazil, November 11-13, 1919, Cornell U. Exp."

*Type*.—In the collection of Cornell University.

**BEMBIX INCOGNITA, new species**

*Type* (female).—Black: labrum; mandibles, except tips; clypeus; lower part of frons; scape, except spot above; broad anterior orbits joined by a transverse band below the anterior ocellus, and above this point deflected away from the eyes and continued to the vertex; broad posterior orbits continued at the vertex beyond the border of the eyes but not meeting; prothorax; broad lateral lines and prominent U-shaped discal mark on scutum; broad fascia on posterior border of scutellum; metanotum; broad fascia on propodeum; posterior surface, lateral angles, and sides of propodeum

almost completely; metapleura; mesopleura; mesosternum, except spot in front of middle coxa; broad fasciae occupying the middle of tergites 1-5, the first bearing a prominent median anterior emargination, the second and third each enclosing a pair of black discal spots, the fourth biemarginate on anterior border, the fifth narrowed and interrupted at mid-dorsal line; sixth tergite with broad V-shaped apical maculation; sternite two with pair of anterior lateral spots and pair of posterior lateral spots joined by a narrow apical line; sternites 3-5 with posterior lateral spots joined by apical lines; legs, except more or less black on coxae and trochanters, a black stripe above on all femora, and some black below on anterior tibiae; *yellow*.

The flagellum is ferruginous, somewhat darker above than below, especially in the case of the first two segments. The clypeus is not more prominent than normal and is only slightly carinate on midline at the base. The eyes are but slightly divergent at the clypeus. The anterior metatarsus is provided with six spines. The wings are hyaline and the left front wing bears a small triangular accessory cell between the first and second cubital cells. The pubescence is very short and sparse. The legs of the U-shaped discal mark on the scutum are distinctly reddish in color.

Length 20 mm. Described from a single female (type) bearing only the label, "Coll. Bingham." It bears no locality label whatever. In general appearance it resembles *melancholica* Smith and *taiwana* Bischoff, but the maculations are more extensively developed and are also brighter in color than on those two species.

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

#### Genus MICROBEMBEX Patton

Figures 9, 10

*Microbembex* PATTON, Bull. U. S. Geol. Surv., vol. 5, 1879, p. 364.—Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 363.—Kohl, Ann. des K. K. Naturhist. Hofmus., vol. 11, 1896, p. 434.—PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 117.

*B. Bembecis aberantes* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893, p. 878.

*Bembex* Fox (part), Proc. Acad. Nat. Sci. Phila., 1894, p. 303.—DALLA TORRE (part), Cat. Hym., vol. 8, 1897, p. 501.

*Genotype*.—*Bembex monodonta* Say by original designation.

Members of this genus differ from those of the genus *Bembix* and other allied genera in that the distal end of the radial cell does not lie on the anterior margin of the wing (fig. 10).

Head wide as thorax; middle of vertex slightly depressed below the level of the top of the eyes; frons unusually wide, making up half,

and in some species more than half, of the total width of the front aspect of the head; anterior ocellus reduced to a linear, transverse, arcuate cicatrice; clypeus prominent, bulging, in some species, when viewed from the side, resembling a blunt nose; mandibles edentate; maxillary palpus composed of three segments, labial of one; first intercubitus straight; metacarpus at its apical end not confluent with the anterior margin of the wing; posterior-lateral angles of propodeum rounded, its posterior, dorsal, median border somewhat prominent and overhanging somewhat the slightly excavated posterior surface of the segment; second sternite of male usually provided with a more or less well developed median process; eighth sternite ending in a single spine; spatha of male genitalia as in Figure 57.

## KEY TO SPECIES OF MICROBEMBEX

1. Males (visible segments in abdomen 7; segments in antenna 13)-----2.  
Females (visible segments in abdomen 6; segments in antenna 12)-----7.
2. Seventh tergite bearing distinct lateral spines-----*bidens*.  
Seventh tergite without lateral spines-----3.
3. Hind femur near middle point distinctly widened, forming rounded obtuse angle on posterior border (fig. 49)-----*sulphurea*.  
Hind femur not thus developed-----4.
4. Seventh tergite with evident rounded lateral angles, best seen in ventral view (fig. 54)-----*tricolora*.  
Seventh tergite not so developed-----5.
5. Process on second sternite long and curved (fig. 64); clypeus, large spot on mesopleura, and large discal spots on scutum, yellow-----*aurata*.  
Process on second sternite otherwise; above combination of maculations not present-----6.
6. Process on second sternite blunt and hirsute (fig. 66)-----*hirsuta*.  
Process on second sternite otherwise-----*monodonta*.
7. Sixth tergite at base with distinct lateral spinelike angles-----*natalis*.  
Sixth tergite without basal lateral angles-----8.
8. Anterior metatarsus with eight spines-----*bidens*.  
Anterior metatarsus not with eight spines-----9.
9. Posterior apical angle of anterior metatarsus not extended in form of prominent lobe; apical emargination of clypeus ellipsoid in form (fig. 61).  
*nasuta*.  
Posterior apical angle of anterior metatarsus extended in form of prominent lobe; apical emargination of clypeus arcuate in form (fig. 9)-----10.
10. Anterior metatarsus with seven spines; second abscissa of cubital vein equal in length to second abscissa of radial; length 15 mm-----*equalis*.  
Anterior metatarsus not with seven spines; second abscissa of the cubital vein not equal in length to second abscissa of radial-----11.
11. Fasciae on tergites bicolored, yellow dorsally, pale or creamy colored laterally (Jamaica)-----*tricolora*.  
Fasciae on tergites uniform in color, yellow or pale-----12.
12. Pubescence on head, thorax, and propodeum unusually long and dense, very conspicuous on dorsum and lateral angles of propodeum-----*hirsuta*.  
Pubescence not unusually long and dense-----13.

13. Clypeus unusually prominent, the depth of its apical emargination is to the greatest width of the emargination as three is to four-----sulphurea.  
 Clypeus less prominent, depth of the apical emargination as compared with the width of the emargination not as above-----14.
14. Clypeus, scape, mesopleura, and large discal spots on scutum, yellow--aurata.  
 Combination of maculation as given above not present-----monodonta.

**MICROBEMBEX BIDENS**, new species

Figures 56-59

This species differs from all other species of the genus so far described, in that the anterior metatarsus on both males and females is provided with eight spines. The clypeus is very prominent and the depth of its apical emargination is to the width of the emargination approximately as four is to five. The maxillary palpus is composed of four segments, the labial of two. The seventh tergite of the male bears a pair of lateral apical spines and the median terminal portion is broad and emarginate at the apex (fig. 59). The male genitalia are distinct, as shown in Figure 57, and the spine on the eighth sternite bears on its ventral surface a short spine (fig. 56). The second sternite of the male near its posterior border bears a transverse, swollen area, which bears at its posterior midventral point a short, pointed tubercle. The apex of the sixth tergite of the female is deeply emarginate, causing the tergite to end in a pair of short spines (fig. 58). The pubescence on the head, thorax, and propodeum is short, relatively sparse and somewhat silvery, especially on the frons. The wings are hyaline.

*Type* (male).—Black: labrum; mandibles, except tips; clypeus, except black border at base; scape, except small spot above; anterior orbits shortened and narrowed above; spot below anterior ocellus; posterior orbits; posterior border of pronotum and of sides of prothorax, including tubercles; lateral lines broad anteriorly and pair of discal lines on scutum; fascia on scutellum greatly narrowed at midline; fascia on metanotum; broad, curved fascia on propodeum; lateral angles continuous with sides of propodeum; large spot on mesopleura; broad, continuous fasciae on the tergites (rendering the dorsum of the abdomen, when straightened, almost entirely yellow); second sternite almost wholly; continuous fasciae on sternites 3-7, narrow on the more posterior sternites; legs, except some black on coxae, trochanters, and femora above; *yellow*.

The *allotype* (female) differs in color but little from the type. There is no black on the clypeus; the posterior orbits are extended on the vertex; the fasciae on the tergites and sternites are not quite so well developed; and the black on the femora is a little more extensive.

On the type and on some of the paratypes the fascia on the first tergite incloses a pair of small, approximated, black, discal spots. On some specimens these spots are joined, forming a single median spot. Variation in the character and extent of the maculations is usually great in species of this genus, but in the case of this species, as represented by the 14 specimens at hand, variation in the maculation is very slight. All males have a black border at the base of the clypeus; this black border is lacking on all females. On the females the discal marks on the scutum are broad and on some these marks assume a broken U-shaped form.

Length 14 mm. Described from seven males and seven females (including the type and allotype), of which 13 bear the label, "La Rioja, W. Argentina, B. P. Clark, donor." The remaining specimen, a female, bears the label, "Pie de Palo, San Juan, Argentina, 11 March, 1920, Cornell U. Expedition."

*Type and allotype*.—Cat. No. 40851, U.S.N.M.

MICROBEMBEX SULPHUREA (Spinola)

Figures 49, 50

*Bembex sulphurea* SPINOLA, Gay's Hist. Fis. y Polit. de Chile, vol. 6, 1853, p. 319.

*Bembex sulfurea* HANDLIRSCH, Stiz. Akad. Wissensch. Wien, Math. Nat. Cl., vol. 102, 1893, p. 885.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 514.

The males of this species have the hind femora dilated at the middle point (fig. 49), a character that, so far as I am aware, is not possessed by any other species of the genus. Furthermore, the spine of the eighth sternite has a distinct hook at the tip, as is shown in Figure 50. Apparently Handlirsch overlooked this in his description of the species. The females (and males also) have the clypeus strongly prominent so that its junction with the frons at the midline forms an angle more nearly approaching a right angle than on any other species except *nasuta*. The apical emargination of the clypeus for the junction with the labrum is greater than a semicircle, so that the depth of the emargination compared with its extreme width is approximately as 3 is to 4. The size of the individuals, the color of the maculations, and the extent of their development all vary greatly.

Among the specimens of this species before me are two males, identified by Handlirsch and bearing the label, "Oberer Magdalenen, Strom"; a male identified by Kohl and bearing the label, "Chile, Concepcion, 1903, Herbst"; a female identified by Handlirsch and bearing the label, "Brasilien"; and a female identified by Reed and bearing the label, "Chile, E. C. Reed." In addition to these I have



referred to this species a male from southern Chile, collected by M. J. Rivera, and females collected at Rio Janeiro, Bogata, Cayenne, and La Paz, Bolivia.

**MICROBEMBEX TRICOSA, new species**

Figures 53-55

This species is based upon specimens from Jamaica. The male is distinguished by the evident rounded lateral angles of the seventh tergite, which give to the apex of the tergite a distinct triangular outline (fig. 54). The spine of the eighth sternite is flattened, straight, and truncate at the apex. On the female the fasciae on the tergites are of two colors: the dorsal median portion is yellow or greenish yellow, while the lateral parts are creamy yellow or pale. The pubescence on the frons of the female is silvery on the lower part and on the areas bordering the eyes, but that on the upper central part shows a decided golden tinge. The pubescence on the frons of the male is distinctly golden.

*Type* (male).—Black: labrum; clypeus; mandibles except tips; scape below; vestiges of posterior orbits; central spot on dorsum of prothorax united with a line on posterior border of pronotum that is continuous on tubercles and sides of prothorax; lateral lines and pair of large discal spots on scutum; large lateral spots showing a tendency to elongate along the anterior border of scutellum; metanotum; broad, curved fascia on propodeum narrowed at midline; large triangular spot on mesopleura; broad fasciae occupying almost the entire surface of tergites 1-6; fascia on second tergite inclosing pair of small, widely separated discal spots; fasciae on tergites 3-6 with widely separated, more or less evident biemarginations and median notch on anterior border; pair of lateral apical spots on tergite 7; broad fascia on sternite 2; broad fascia on sternite 3 deeply biemarginate on anterior border; lateral spots on sternites 4-6 connected by posterior apical lines; coxae and trochanters more or less; femora, except more or less of the basal half of all; tibiae, except spot below on all; and tarsi; *yellow*.

The maculations on the *allotype* (female) do not differ essentially from those on the type, except on the abdomen. The fasciae on the tergites of the *allotype* are bicolored, as has been noted above, and are much narrower than those on the type. While they are somewhat sinuate on the anterior border, they are not emarginate and all are without discal spots. The fifth is interrupted. The sixth tergite bears apical lateral spots. There are lateral spots on sternites 2-5, of which those on 2-4 are connected by narrow, apical lines. The black on the legs is somewhat more extensive than on the type. The sixth tergite ends in two short spines (fig. 53).

The wings of this species are somewhat infumated, the infumation being more evident on the middle of the wing than elsewhere, more evident on the female than on the male, and more conspicuous on some individuals than on others. The anterior metatarsus is provided with six spines. The variation in the maculations, as shown by the specimens before me, is not great. On two of the male paratypes the fascia on the first tergite also incloses a pair of discal spots, and on a female paratype the fasciae on both fourth and fifth tergites are interrupted. On all other female paratypes all fasciae on the tergites are continuous.

Cresson described two species in this genus from specimens obtained from Cuba, *argentifrons* and *armata*. I have seen the specimens on which these two species are based and I am of the opinion that *argentifrons* is only a form of *monodonta* Say. The male that Cresson referred to his *armata* represents, in my judgment, a distinct species, but whether this male and the female with which he associated it are sexes of the same species is open to question. The female (which Cresson made the type of *armata*) does not have the golden pubescence on the frons that is so conspicuous on the male of *armata*, but it does have the mixed silvery and golden pubescence such as is found on the frons of the species I have just described. Furthermore, I have before me a single female from Cuba that does have the golden pubescence on the frons in all respects similar to that of the male of Cresson's *armata*. If further investigation shall show that the female of *armata* Cresson and the female of the species above described belong to the same species, my species will fall as a synonym under *armata* Cresson and a new species will have to be described, based upon the male of Cresson's *armata*. In this connection I wish to state that there is one thing of which I am certain: that is that the male of *tricosa* is distinct from the males that Cresson referred to *armata* and *argentifrons*.

Length 12 mm. Described from five males and six females, including the type and allotype, all from Jamaica.

*Type*.—Cat. No. 40852, U.S.N.M.

MICROBEMBEX AURATA Parker

Figure 64

*Microbembex aurata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 121.

This species differs from *monodonta* in its slightly larger size, in its more extensive and richer yellow maculations, and particularly in the character of the genital stipites of the male. Only three specimens are found in the United States National Museum: the type,

bearing the label, "California"; the allotype, bearing the label "Los Angeles Co., California"; and a male bearing the label, "Bill Wms. Fork, Ariz., Aug., F. H. Snow."

**MICROBEMBEX HIRSUTA Parker**

Figure 66

*Microbembex hirsuta* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 122.

The male of this species may be distinguished from the male of *monodonta* by the form and the hirsute character of the process on the second sternite. It is further distinguished from *monodonta* by the form of the genital stipites. The females are distinguished from the female of *monodonta* by the unusual development of the pubescence on the head, thorax, and propodeum, especially on the dorsum of the propodeum. On many of the females that I have referred to this species the black on the abdomen has been replaced by brown of varying shades. These brown forms are believed to be specimens that were captured just after emergence from the pupal condition.

SPECIMENS EXAMINED

ARIZONA: Yuma (August, 1905, Hbt. Brown).

CALIFORNIA: Bard (July 22, H. R. Reed).

TEXAS: Rio Grande, near Boquillas, Brewster County (June, 1908, Mitchell and Cushman).

**MICROBEMBEX MONODONTA (Say)**

Figures 9, 10, 65

*Bembex monodonta* SAY, Nar. Exp. St. Peters River, Append., 1824, p. 335.—  
HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 102, 1893,  
p. 882.

*Microbembex monodonta* PATTON, Bull. U. S. Geol. Surv., vol. 5, 1879, p. 362.—  
PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, pp. 119, 134.

*Microbembex tarsalis* ROHWER, Proc. U. S. Nat. Mus., vol. 47, 1914, p. 516.

This seems to be the most widely distributed species among the Bembicids of the western continent. It has been reported from practically every State in North and South America. Among the hundreds of specimens I have examined, representing localities widely distributed over both North and South America, I find great variation in the color of the maculations, in the extent to which these maculations are developed, and their distribution on the body. So far, I have been unable to find any structural variations to correspond to these color variations, and, in fact, no consistency in the color variations themselves. I am, therefore, obliged to consider this large

group as a single species, since I am unable to discover trustworthy characters, based either on structure or color, that will enable me to separate it into two or more species or even into well-defined varieties.

MICROBEMBEX NATALIS, new species

Figures 51, 52

*Type* (female).—Black: clypeus; labrum; mandibles, except tips; area on frons between antennae extended upward and narrowed to a point connecting it with a spot below anterior ocellus; scape below; broad anterior orbits deflected inward above anterior ocellus; posterior orbits very broad below, narrowed above and extended across the vertex a short distance, but not united; prothorax, except transverse spot above and vertical spot on side; lateral lines, and a U-shaped spot whose anterior ends are much dilated, on scutum; fascia, enlarged somewhat laterally, on posterior border of scutellum; fascia on metanotum; broad fascia on propodeum and its lateral angles broadly; metapleura; mesopleura almost wholly; very broad fascia on first tergite enclosing a pair of kidney-shaped discal marks whose concave sides face laterally and whose anterior ends are further separated than their posterior ends; broad, continuous fasciae on tergites 2—5, whose margins are slightly sinuate; apex of sixth tergite broadly; broad lateral spots joined by a narrow apical fascia on sternites 2 and 3; lateral spots on sternites 4 and 5 prolonged toward the midline but not connected; coxae and trochanters in part; femora, except line above on all; tibiae, except line below on first and second pairs and line above on third pair; and tarsi; *yellow*.

The flagella are broken, only a portion of the base of one remains. This is black above and rusty brown below. The wings are hyaline. The clypeus is remarkably flat for a member of this genus, showing scarcely any of the prominence so evident in *monodonta*. The pubescence is white and remarkably short and sparse. The sixth tergite bears basally well-defined lateral angles, which, owing to the curvature of the tergite, point almost directly downward. This tergite ends in a pair of well-defined points.

It is just possible that the specimen on which this species is based may belong to Smith's *gratiosa*, but if Smith's description of his species is complete and accurate, it does not belong there. Furthermore, Handlirsch, who gives a figure of his species, *uruguayensis*, says that the abdomen of the female of *gratiosa* is quite similar to that of *uruguayensis*. If his conclusions are correct, this female represents a good species, for the sixth tergite is quite different from that of *uruguayensis* as represented in the figure given by Handlirsch.

Length 13 mm. Described from a single female bearing the label, "Natal, Brazil, W. M. Mann."

*Type*.—Cat. No. 40853, U.S.N.M.

MICROBEMBEX NASUTA, new species

Figures 60, 61

This species is described from two females and is distinguished from all other species in the genus by the peculiar form of the clypeus, as shown in Figures 60 and 61. It is unusually prominent and bulging, the depth of its apical emargination for articulation with the labrum being approximately equal to the greatest width of this emargination. The species is further distinguished by the fact that the posterior apical angle of the anterior metatarsus is not produced into a prominent lobe, a development found on all other species of the genus.

*Type* (female).—Black: mandibles, except tips; clypeus; labrum; scape; frons between antennae; spot on frons below anterior ocellus; very broad anterior orbits, not reaching the vertex and dilated inward at their dorsal extremity; very broad posterior orbits, almost united across the vertex; prothorax; broad, lateral lines and pair of broad, discal lines on scutum; scutellum, except median longitudinal black stripe; metanotum; very broad, curved fascia on propodeum; lateral angle, posterior surface, and sides of propodeum; metapleura; mesopleura and mesosternum; all tergites; sternites entirely, except narrow, black anterior border on fifth and sixth: legs entirely; *pale, almost clay-colored yellow*. On the anterior sternites the color is a more decided yellow.

The flagellum is dark above, almost black on some segments; below it is a light shade of ferruginous. The wings are hyaline and long, reaching the end of the abdomen. The pubescence is white, and although dense, is exceedingly short. The apex of the sixth tergite is slightly and roundly emarginate.

The paratype differs from the type in being a trifle larger and in having the yellow on the tergites somewhat less extensive. The fascia on the first tergite bears a median anterior emargination; that on the second has a pair of shallow, rectangular anterior emarginations; and tergites 3, 4, and 5 each shows an irregular, shallow black border on anterior margin, variable in outline. Tergite 6 shows an anterior black border. The basal joints of the legs also show dark markings, not being wholly yellow as on the type.

Length 15–17 mm. The type bears the label, "Pie de Palo, San Juan, 11 March, 1920, Argentine, Cornell U. Expedition." The paratype bears the label, "Argentina, Mendoza, 22. 12. 1906, Jensen Haarup V."

*Type*.—In the collection of Cornell University; paratype in the Zoologisches Museum der Universität, Berlin.

**MICROBEMBEX EQUALIS, new species**

Figures 62, 63

*Type* (female).—Black: labrum; mandibles, except tips; clypeus, except black basal band, emarginate at apical middle; scape below; trace of anterior orbits opposite sides of clypeus; posterior orbits; narrow posterior border of pronotum; tubercles; small spot on side of prothorax; short lateral lines above base of wings on scutum; small lateral spots on scutellum; fascia on metanotum; curved fascia on dorsum and posterior surface of propodeum; spot on ventral border of mesopleura; broad, continuous fascia on tergites 1–6, the anterior borders being slightly irregular and acutely emarginate at dorsal midline; continuous apical fasciae on sternites 2–6, somewhat enlarged at lateral extremities and also at midventral line; spot on coxae variable in extent; distal part of femora varying in extent on the different pairs; tibiae, except spot below on anterior and middle pairs; and tarsi; *light greenish yellow or pale creamy white*. The fasciae on the tergites, except their extreme anterior borders, are almost white, while the shade of yellow on the tibiae and tarsi is deeper than elsewhere on the body.

The frons is very wide and the inner eye-margins are parallel. The flagella are black. The clypeus is prominent, in this respect agreeing with *monodonta*. The pubescence is dense, white, and of normal length, being longest on head, sides of thorax and lateral angles of propodeum. When viewed at the proper angle the pubescence appears silvery, especially on frons and clypeus. The anterior metatarsus bears seven spines, of which the four on the distal portion are large and black in color, while the three on the proximal part are much smaller in size and are light in color. The second abscissa of the radius and the second abscissa of the cubitus are equal in length, whereas in other species the second abscissa of the radius is appreciably longer than the second abscissa of the cubitus. The sixth tergite ends in two distinct points (fig. 63).

Length 15 mm. Described from a single female bearing the label, "Tingo, Peru, Aug. 17 (Cockerell)."

*Type* (male).—Cat. No. 40854, U.S.N.M.

**Genus BICYRTES Lepeletier**

Figures 15, 16, 40

*Bembex* OLIVIER (part), *Encycl. Meth.*, vol. 4, 1789, p. 288.

*Monedula* DAHLBOM (part), *Hym. Eur.*, vol. 1, 1845, p. 492.

*Bicyrtes* LEPELETIER, Hist. Nat., vol. 3, 1845, p. 53.—PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 56.

Genotype: *Bicyrtes* (*servilii* Lepeletier) *ventralis* SAY. Monobasic.

*Bembidula* BURMEISTER, Bol. Acad. Cordova, vol. 1, 1874, p. 122.—HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 473.—KÖHL, Ann. des K. K. Naturhist. Hofmus., vol. 11, 1896, p. 442.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 494.

Genotype: *Monodula discisa* TASCHENBERG. Designated by Parker in 1917.

Members of this genus are distinguished from those of other genera of the tribe by the peculiar form of the propodeum, whose posterior surface is distinctly concave and whose posterior-lateral angles (except in a single species) are extended, compressed, and wedgelike. The anterior ocellus is reduced to a transverse, linear, arcuate cicatrice and the eighth sternite of the male ends in three points.

Head wide as thorax; vertex on a level with the top of the eyes, the middle part being slightly above this level; anterior ocellus completely reduced to a linear, transverse, arcuate cicatrice; inner eye-margins somewhat divergent at the vertex; mandibles dentate; clypeus broad and only moderately arched; labrum about as long as broad at the base, its apex rounded, not emarginate; maxillary palpus composed of six segments, labial of four; posterior surface of propodeum concave, its posterior-lateral angles (except in a single species) extended, compressed, and wedgelike; second cubital cell strongly narrowed on the radial vein; pubescence always short, practically wanting on the abdomen; second sternite of male may or may not bear a process; eighth sternite of male ending in three spines; spatha of male genitalia as in Figure 40.

KEY TO THE SPECIES OF BICYRTES

1. Males (abdomen with 7 visible segments; antenna with 13 segments).....2.  
Females (abdomen with 6 visible segments; antenna with 12 segments).....22.
2. Posterior coxa with tooth on inner distal margin.....*fodiens*.  
Posterior coxa without tooth.....3.
3. Middle femur with tooth at base below.....4.  
Middle femur without tooth at base below.....5.
4. Ultimate tergite black; fasciae on tergites narrow.....*ventralis*.  
Ultimate tergite maculated; fasciae on tergites broader.....*parata*.
5. Anterior tarsus greatly dilated; segments broad and flat.....*odontophora*.  
Anterior tarsus normal; segments not broad and flat.....6.
6. Fifth segment of the flagellum wider than any other segment; apical segment of all tarsi wholly or in part black.....*discisa*.  
Fifth segment of flagellum not widened; apical segment of tarsi otherwise.....7.
7. Second sternite with distinct median process or tubercle.....*tricolorata*.  
Second sternite without process or tubercle.....8.
8. Mesopleura more or less conspicuously maculated.....9.  
Mesopleura black.....13.

9. Anterior wing heavily clouded at first cubital cell.....*viduata*.  
 Anterior wing without heavily clouded area.....10.
10. Fasciae on tergites attenuated medially; that on sixth reduced to widely separated spots.....*quadrifasciata*.  
 Fasciae not attenuated medially; that on sixth tergite not reduced to widely separated spots.....11.
11. Fascia on posterior border of scutellum continuous, or if interrupted, the lateral spots show a tendency to extend along the posterior border; genital stipes as in Figure 221.....*annulata*.  
 Fascia on anterior border of scutellum continuous, or if interrupted, the lateral spots show a tendency to extend along the anterior border; genital stipes otherwise.....12.
12. Discal marks on scutum narrow longitudinal lines; sides of thorax profusely yellow; genital stipes as in Figure 45.....*variegata*.  
 Discal marks on scutum oval spots; yellow on side limited to spot on mesopleura; stipes otherwise.....*spinosa*.
13. Anterior wings heavily clouded at first cubital cell.....14.  
 Anterior wings without clouded area; infumation, if present, diffused....15.
14. Dorsum of propodeum unmarked; genital stipes as in Figure 48....*gracilis*.  
 Dorsum of propodeum marked with yellow fascia more or less complete; genital stipes as in Figure 47.....*viduata*.
15. Flagellum black; fascia on sixth tergite wanting or more widely interrupted than preceding fasciae.....16.  
 Flagellum not wholly black; fascia on sixth tergite always developed and scarcely more widely interrupted than the other fasciae.....19.
16. Sternites without maculations.....18.  
 Sternites 2-4 with lateral maculations.....17.
17. Discal spots on scutum; fascia on metanotum; fasciae on tergites, orange yellow.....*spinosa*.  
 Discal spots on scutum lacking; metanotum without fascia; fasciae on tergites creamy white.....*quadrifasciata*.
18. Tergites 1-5 maculated; wings slightly but uniformly infumated.  
*quinquemaculata*.  
 Tergites 1-4 maculated; wings hyaline.....*pullata*.
19. Scape, first two joints of flagellum, and legs ferruginous; genital stipes as in Figure 46.....*insidiatrix*.  
 Scape and first two joints of flagellum not entirely ferruginous; legs black and yellow, or black and ferruginous; genital stripes otherwise.....20.
20. Metanotum without fascia; fasciae on tergites narrow; ultimate tergite narrowed and bluntly pointed at the apex.....*tristis*.  
 Fascia on metanotum; fasciae on tergites relatively broad; ultimate tergite otherwise.....21.
21. Legs black and ferruginous; maculations deep yellow, frequently with dashes of ferruginous.....*capnoptera*.  
 Legs black and yellow; markings pale creamy yellow with no trace of ferruginous.....*mesillensis*.
22. Second sternite bearing pair of small processes; sixth tergite as in Figure 41.  
*bradleyi*.  
 Second sternite without process; sixth tergite otherwise.....23.
23. Posterior coxa with tooth on inner distal margin.....24.  
 Posterior coxa without tooth.....25.



24. Fasciae on tergites narrow; ultimate tergite black..... *fodiens*.  
 Fasciae on tergites broad; ultimate tergite yellow..... *burmeisteri*.
25. Ultimate tergite with pygidial area and lateral ridges, sometimes weakly developed..... 26.  
 Ultimate tergite without pygidial area and lateral ridges..... 28.
26. Scutum without discal marks; mesopleura black, rarely with inconspicuous maculation; fasciae on tergites interrupted medially..... 27.  
 Scutum with discal markings; mesopleura with evident yellow maculation; fasciae on tergites usually continuous..... *annulata*.
27. Fasciae on posterior tergites shortened or narrowed laterally; sixth tergite black..... *capnoptera*.  
 Fasciae on posterior tergites not shortened or narrowed laterally; sixth tergite with pair of small maculations..... *pexa*.
28. Lateral angles of propodeum acuminate; all fasciae on tergites continuous. *angulata*.  
 Lateral angles of propodeum normal form; not all fasciae on tergites continuous..... 29.
29. Mesopleura black..... 30.  
 Mesopleura maculated with yellow more or less..... 32.
30. Flagellum and legs for the most part ferruginous; apex of ultimate tergite ferruginous; fascia on first tergite broad and best developed..... *insidiatrix*.  
 Flagellum black; legs black and yellow or black and ferruginous; ultimate tergite not ferruginous; fascia on first tergite narrow, not better developed than the others..... 31.
31. Ultimate tergite maculated..... *parata*.  
 Ultimate tergite black..... *ventralis*.
32. Ultimate tergite wholly yellow..... *sola*.  
 Ultimate tergite black..... 33.  
 Ultimate tergite with lateral maculations..... 37.
33. Anterior wing clouded at first cubital cell..... *viduata*.  
 Anterior wing not clouded at first cubital cell..... 34.
34. Fascia on fifth tergite much more widely interrupted than that on the first, or it may be lacking; discal marks on scutum lacking or reduced to narrow lines..... *quadrifasciata*.  
 Fascia on fifth tergite always present and scarcely more widely interrupted than that on first; discal marks on scutum prominent spots..... 35.
35. Lateral spots on scutellum tending to extend themselves along the anterior border of the sclerite; fasciae on tergites orange yellow..... *spinosa*.  
 Lateral spots on scutellum tending to extend themselves along the posterior border of the sclerite; fasciae on tergites creamy yellow..... 36.
36. Tibiae marked with black..... *discisa*.  
 Tibiae wholly yellow..... *mendica*.
37. Fasciae on all tergites interrupted..... 38.  
 Fasciae, one or more, continuous..... *parata*.
38. Scutum without discal markings..... *mesillensis*.  
 Scutum with pair of discal lines or spots..... 39.
39. Fascia on anterior border of scutellum usually narrowly interrupted at midline..... *variegata*.  
 Fascia on scutellum reduced to lateral spots that tend to extend themselves along the posterior border of the scutellum..... *discisa*.

## BICYRTES FODIENS (Handlirsch)

Figure 38

*Bembidula fodiens* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 497.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 495.

*Bicyrtes fodiens* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 60.

This species and the one following (*burmeisteri*) are distinguished from all others of the genus known to me by the presence of a tooth on the inner apical margin of the posterior coxa. The female of this species may be distinguished from the female of *burmeisteri* by the color of the sixth tergite, which is black on *fodiens* and yellow on *burmeisteri*. The form of the sixth tergite is shown in Figure 38.

## SPECIMENS EXAMINED

GEORGIA: Spring Creek, Decatur County (July 16, 1912).

LOUISIANA: East Point (September 5, 1907, F. C. Bishopp); New Orleans (Ed Foster).

MISSISSIPPI: Utica (Ashmead).

MISSOURI: St. Louis (Rau).

TEXAS: Calvert (June 27, 1907, F. C. Bishopp).

## BICYRTES BURMEISTERI (Handlirsch)

*Bembidula burmeisteri* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 98, 1889, p. 500.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 494.

*Bicyrtes burmeisteri* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 62.

I have before me three females that I have referred to this species, all of which vary somewhat from Handlirsch's description of the species. But, since the original description was made from a single specimen, some variation from the description is to be expected. No specimen has any maculation on the mesopleura. All have narrow apical fasciae joining the lateral spots on the sternites. One (from Texas) has the scape wholly yellow. Of the other two (from Mexico) one has a well-developed, curved fascia on the propodeum, while the other has no trace of such a fascia. The specimen from Texas and one of the two from Mexico have conspicuous lateral spots and a pair of small discal spots on the first tergite, whereas the second one from Mexico has the first tergite wholly black. This specimen and the one from Texas have the wings but slightly infumated but the other Mexican specimen has the wings almost as heavily infumated as are the wings of *fodiens*. So far as I am aware, the male of this species has not been described.

## SPECIMENS EXAMINED

MEXICO: Guadalajara (July 5, 1903, McClendon).

TEXAS: Brownsville (September 29, 1906, J. C. Crawford).

**BICYRTE VENTRALIS (Say)**

Figure 16

*Monedula ventralis* SAY, Exp. St. Peters River, vol. 2, 1824, p. 336.

*Bicyrtes servillii* LEPELETIER, Hist. Nat., vol. 3, 1845, p. 63.

*Bembidula ventralis* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 495.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 496.

*Bicyrtes ventralis* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 62.

This is the most abundant species of the genus in North America and is widely distributed over the United States and Canada. In the western part of the United States it is largely replaced by *parata*. The males of these two species are the only ones that have the middle femur provided with a distinct tooth near the proximal end below. Along with the wide dispersal of *ventralis* goes a wide variation in the extent and color of the maculations, and this variation holds true for both males and females. The color varies from orange yellow through lighter shades to light creamy white. My observations on this species seem to indicate that in the western part of its range it appears only in the light-colored forms. The wings are infumated, but the degree of infumation also varies.

**BICYRTE PARATA (Provancher)**

*Monedula parata* PROVANCHER, Add. Hym. Quebec, 1888, p. 416.

*Bembidula parata* FOX, Proc. Acad. Sci. Phila., 1895, p. 353.

*Bembidula meliloti* ROHWER, Ent. News, vol. 19, 1908, p. 376.

*Bicyrtes parata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 64.

This is a western species and as now recognized appears under two forms, one in which both males and females have the maculations yellow and the other in which both males and females have the maculations white. As was pointed out in the notes on *ventralis*, that species and this one, in regard to the male, are characterized by the presence of a tooth on the middle femur. Furthermore, the antennae of the males of these two species have the same modifications. The male genitalia of the two species show no trustworthy differences. Even the infumation of the wings can not be relied upon to separate the two species. It follows, therefore, that we must depend upon the maculations, upon their extent and their color, for characters with which to separate the two species.

On typical forms of *parata* the color of the maculations is yellow, the fasciae on the tergites are broad, either all narrowly interrupted or some interrupted and some continuous. In addition, the sixth tergite of the female and the seventh of the male bear conspicuous lateral spots. In typical forms of *ventralis* the fasciae on the tergites are always interrupted, relatively narrow, and the fascia on the first tergite is much reduced or wanting. The sixth tergite of the female and the

seventh of the male are invariably black. Unfortunately, all specimens are not typical, and it is these nontypical forms that cause the difficulty in identification. The white forms of *parata* might be considered a distinct species were it not for the fact that there is an intermediate series passing by gradations over to the yellow form of *parata* on the one side and another series passing likewise over to *ventralis* on the other side. Much more work must be done in the field before the problem here presented can be solved in a satisfactory manner.

## SPECIMENS EXAMINED

CALIFORNIA: Los Angeles County (September, Coquillet); San Bernardino County (May, Coquillet).

NEW MEXICO: Pecos (September 2, Cockerell).

TEXAS: Round Mountain (Coquillet).

WASHINGTON: Spokane (July 7, 1924, J. M. Aldrich).

The species has also been reported from Utah and Arizona.

## BICYRTES ODONTOPHORA (Handlirsch)

## Figure 36

*Bembidula odontophora* HANDLIRSCH, Sitz. Akad. Wissensch, Wien, Math.-Nat. Cl., vol. 98, 1889, p. 482.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 495.

The male of this species can not be confused with that of any other species known to me. The dilated and flattened segments of the anterior tarsus give to the males of this species a character unique in the genus. Handlirsch separates the females of this species from those of *discisa*, which most closely resemble it, chiefly on the character of the punctation of the scutellum, which is much finer than on *discisa*. This character, unless both species are available for comparison, is difficult to use. I have before me a single female that I have referred to this species. The discal maculations on the scutum are lines and the lateral spots on the scutellum are approximately rectangular, whereas the corresponding maculations on *discisa* are really spots on the scutum and triangular spots on the scutellum. The female of *mendica* is distinguished from both *discisa* and *odontophora* by having the tibiae and the tarsi entirely yellow.

## SPECIMENS EXAMINED

BOLIVIA: Near mouth of Rio Maxiri (September, W. M. Mann).

PERU: Puerto Bermudez (Cornell University Expedition).

VENEZUELA: Rio Moto, Cuara District (October, 1909, M. A. Carricker).

The female referred to this species bears the label, "Furo de Resaco, 10 Sept., night. Cornell Univ. Exped." The specimens on which Handlirsch based his description of the species were from Peru.

**BICYRTE DISCISA (Taschenberg)**

Figure 43

*Monedula discisa* TASCHENBERG, Zeitschr. f. d. ges. Nat., vol. 36, 1870, p. 26.  
*Bembidula discisa* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl.,  
 vol. 98, 1889, p. 485.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 495.

The males of this species (and of *odontophora*) have the fifth segment of the flagellum distinctly wider than any other segment in it. In both species the males have the second sternite with an evident process, but *discisa* differs from *odontophora* in having the anterior tarsus of normal form, in having the posterior border of the middle femur plain, and in having the apical segment of all tarsi entirely or in part black. The fasciae on the tergites of both sexes of *discisa* are almost white and are narrow, narrower than those on *spinosa* and much narrower than those on *variegata*.

## SPECIMENS EXAMINED

ARGENTINA: Carcarana (Brunner); Porterillos, Mendoza (March 18-20, 1920, Cornell University Expedition).  
 BOLIVA: Cavinás, Rio Beni (January, 1922, W. M. Mann); Reyer (October 1921, W. M. Mann); Huachi Beni (September, 1921, Mann).  
 BRAZIL: Chapada; Itapura, Matto Grosso (December 8, 1919, Cornell University Expedition); Manaus (Mann and Baker); Natal (Mann); Para (Miss H. B. Merrill); Parintins (September 27, 1919, Parish).  
 COSTA RICA: San Carlos (Schild and Bergdorf).  
 PARAGUAY: Sapucay (March 12, 1902).  
 PERU: La Chorera to La Sombra, Putumayo District (August 21, 1920, Cornell University Expedition); Palcazu (Rosenberg).  
 VENEZUELA: Rio Moto, Cuara District (October 9, M. A. Carriker).

Handlirsch reports this species also from Mexico, Surinam, and Uruguay.

**BICYRTE TRICOLORATA, new species**

Figure 40

*Type* (male).—The maculations on this insect are an unusual combination or fusion of yellow and ferruginous. As distinct from the black ground color the maculations are as follows: labrum; mandibles, except tips; clypeus, except narrow basal border; frons between and below insertion of antennae, except median apical spot; scape and first four segments of flagellum; anterior orbits shortened above; narrow posterior orbits; posterior border of pronotum; side of prothorax, including tubercle; broad, shortened lateral lines on scutum; fascia on posterior border of scutellum interrupted medially; fascia on metanotum; curved fascia on dorsum of propodeum

extended in two points on its posterior surface; posterior lateral angles broadly and vertical anterior line on side of propodeum; metapleura; very large spot on mesopleura enclosing black spot below and prolonged on mesosternum; broad, continuous fasciae on tergites 1-6, those on tergites 2 and 3 narrower on the disk than on the sides of the tergites and notched at dorsal midline; apex of seventh broadly; sternites, except median longitudinal spot on second and basal border more or less on others; legs, except black spots on coxae and trochanters and dark line below on middle and posterior femora. The labrum and the tarsi are yellow; the tibiae are largely yellow; the fasciae on the tergites are a combination of yellow and ferruginous; elsewhere the maculations are either ferruginous or a fusion of yellow and ferruginous.

The antenna is relatively heavy and stout, but aside from color it presents no specific characters. The tegula, the base of the wings and the veins are ferruginous in color and the infumation of the wings is slight and uniform. The second sternite bears a well-developed median, rounded, bluntly-pointed process situated about midway between the basal and apical borders of the sternite. The pubescence on head and thorax is white and short and on the clypeus and lower part of the frons it is silvery. On the abdomen the pubescence has a golden luster and on the seventh sternite it is unusually long and abundant.

Length 18 mm. Described from a single male bearing the No. 3782 and the label, "America Merid."

*Type*.—In the Zoologisches Museum der Universitat, Berlin.

#### BICYRTE VIDUATA (Handlirsch)

##### Figure 47

*Bembidula viduata* HANDLIRSH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 491.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 496.

*Bicyrtes viduata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 69.

This species may be distinguished, both males and females, from all others, except *gracilis*, by the presence of the heavily infumated area (including the first cubital cell) on the anterior wing. It is distinguished from *gracilis* by its more extensive maculations and by the character of the male genitalia.

I have before me of this species eight males and four females, collected by Mitchell and Cushman at Chisos Mountain, Brewster County, Tex., June 10-12, 1908. I have also a female collected by C. F. Baker, labelled "Mexico," and a male that bears the label "San Rafael. Jicoltepec." The localities from which were collected the

two females on which Handlirsch based his description of the species is likewise indefinite.

**BICYRTES QUADRIFASCIATA (Say)**

Figures 15, 44

*Monedula quadrifasciata* SAY, Exp. St. Peters River, vol. 2, 1824, p. 336.

*Bembidula quadrifasciata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 98, 1889, p. 492.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 496.

*Bembidula variegata* Fox, Proc. Acad. Nat. Sci. Phila., 1895, p. 353.

*Bicyrtes quadrifasciata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 65.

This is one of the largest and most easily recognized species in the United States, over the eastern part of which it is widely distributed. It is replaced in Mexico, Central and South America by *variegata*, from which the most elaborately maculated forms of this species can with difficulty be distinguished. The males of the two species can usually be distinguished by the fact that *quadrifasciata* has the scutum black or with weakly developed discal marks and has the fascia on the sixth tergite widely separated or reduced to lateral spots, whereas *variegata* has well-developed discal lines on the scutum and has the fascia on the sixth tergite broad and no more widely interrupted than are the fasciae on the other tergites. In case of doubt the genitalia must be considered. In the case of the female the sixth tergite of *quadrifasciata* is black; of *variegata*, *maculated*.

SPECIMENS EXAMINED

ALABAMA: (C. F. Baker).

CONNECTICUT: Sheffield Island (August 16, 1901, J. L. Zabriskie).

FLORIDA: Crescent City (April 24, 1908, Van Duzee); Enterprise (May 1).

GEORGIA: Okefenokee Swamp, Billy's Island (June 12, 1912); Stone Mountain (August 3, 1913).

ILLINOIS.

INDIANA.

IOWA: Ames.

MARYLAND: Great Falls (July 17, 1915, J. B. Parker).

MASSACHUSETTS: Amherst (July 28, 1905).

NEW MEXICO: Albuquerque (Ashmead).

NEW YORK: Long Island (Ashmead).

OHIO: Cedar Point, Sandusky (July 23, 1913, J. B. Parker).

PENNSYLVANIA: Philadelphia (Skinner).

SOUTH CAROLINA: Calhoun (E. S. G. Titus).

TEXAS: Columbus; Mineola (June 26, 1906, E. C. Bishopp); Rosser (June 7, 1905, F. C. Bishopp); San Antonia (Ashmead).

VIRGINIA: Norfolk (July 15, 1910, F. A. Johnston).

WISCONSIN: N. Hudson, St. Croix County (July 7, 1910); Genoa (July 12, 1911).

The species has been reported also from Kansas and New Jersey.

**BICYRTE ANNULATA** Parker

Figure 221

*Bicyrtes annulata* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 67.

This species stands close to *capnoptera* Handlirsch, the female having the sixth tergite provided with a well-developed pygidial area set off by distinct lateral ridges. It differs from *capnoptera* in having mesopleural maculations, in the greater clearness of the wings, and in the more extensive development of the abdominal fasciae. The type of this species is a female in the collection of the University of Kansas. In a paragraph following the original description of this species the type is referred to as a male. This was an error that I take the opportunity here to correct.

## SPECIMENS EXAMINED

ARIZONA.

CALIFORNIA: Bard (June 15, 1920, H. R. Reed).

NEW MEXICO: Albuquerque (Ashmead); Mesilla Park (September 18, 1899, Cockerell).

TEXAS: Chisos Mountains, Brewster County (June 10-12, 1908, Mitchell and Cushman); Columbus; El Paso (August 21, 1908, F. C. Pratt).

**BICYRTE VARIEGATA** (Olivier)

Figure 45

*Bembex variegata* OLIVIER, Enc. Meth., vol. 4, 1789, p. 292.*Bembidula variegata* HANDLIRSCH, Sitz. Akad. Wissensch, Wien, Math.-Nat. Cl., vol. 98, 1889, p. 488.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 496.

As has been pointed out above, this species is closely related to *quadrifasciata*. The characters, by means of which the two species may be distinguished, are set forth in the discussion of that species.

## SPECIMENS EXAMINED

BOLIVIA: Rurrenabaque, Rio Beni (October, Lopez).

BRAZIL: Chapada (March); Pernambuco (December 8, 1882); Manaus (Miss H. B. Merrill).

BRITISH GUIANA: Bartica (May 10, 1901).

CHILE: Santiago (1923, Father Claude Joseph).

ECUADOR: Guayaquil; Posoria.

GUATEMALA: Livingston (April 18, 1923, E. G. Smyth).

MEXICO: Jicaltepec; Mazatlan; San Juan Bantista.

PARAGUAY: Sapucay (December 17, 1902).

VENEZUELA: Rio Moto, Cuara District (October, 1909, M. A. Carricker).

WEST INDIES: St. Vincent.

Handlirsch reports this species also from Cayenne and Peru.



**BICYRTES SPINOSA (Fabricius)**

Figure 37

*Bembex spinosa* FABRICIUS, Ent. Syst., vol. 4, 1794, p. 458.*Bembidula spinosa* HANDLIRSCH, Sitz Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 487.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 495.

This species bears some resemblance to *variegata*. The discal marks on the scutum, however, are distinctive, being relatively very short and very broad, either oval in outline or triangular, in which case the anterior end of the discal mark forms the base of the triangle. The triangular lateral spots on the scutellum show a tendency to elongate along the anterior border of the sclerite. The color, in well-preserved specimens, is a bright orange yellow. The sixth tergite of some females bears, on the apical part of the tergite, short, weakly-developed lateral lines and the seventh tergite of the male bears well defined, rounded basal lateral angles. On many of the specimens that I have referred to this species, both males and females, there is a conspicuous black spot at the base of the clypeus.

## SPECIMENS EXAMINED

ECUADOR: Guayaquil.

PANAMA: Penta de Pena (July 24, 1908, R. E. B. McKenney).

WEST INDIES: Isle of Pines (July 9, 1900, Palmer and Riley); San Domingo.

Handlirsch reports this species from Cuba.

**BICYRTES MENDICA (Handlirsch)***Bembidula mendica* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat. Cl., vol. 98, 1889, p. 490.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 495.

I have before me two females that I have referred to this species. They were taken at Pie de Paulo, San Juan, Argentina, March 11, 1920, by the Cornell University Expedition.

**BICYRTES GRACILIS Parker**

Figure 48

*Bicyrtes gracilis* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 68.

This species is known only from the type, a male, in the collection of the University of Kansas, collected by F. H. Snow, Santa Rita Mountains, Ariz.

**BICYRTES QUINQUEMACULATA, new species**

Figure 35

*Type* (male).—Black: median spot at base of labrum; small basal spot below on scape; narrow, shortened anterior orbits; narrow,

much reduced, posterior orbits; fascia on metanotum; curved fascia on dorsum of popodeum; posterior lateral angles of propodeum; widely separated spots on tergites 1-5, decreasing in size from one to five; spot at apex of anterior and middle femora; line on anterior border of anterior and middle tibiae and metatarsus; basal part of apical segment of anterior tarsus; *yellow*.

The wings are slightly but distinctly and evenly infumated. The flagella of the antennae are lost, only the first and second segments of one remain and these are black. The second sternite on the midline basally bears a carina that extends about half the length of the sternite, but does not terminate in a process or tooth. The pubescence on the labrum, clypeus, and lower part of frons is quite short and silvery. Elsewhere it is short or lacking.

Length 17 mm. Described from a single male collected by William M. Mann at Carinas Beni, Bolivia, January, 1922.

*Type*.—Cat. No. 40855, U.S.N.M.

**BICYRTES PULLATA, new species**

*Type* (male).—Black: short, narrow anterior orbits; small spot at base of scape below; minute lateral spot on scutellum; fascia on metanotum; fascia on propodeum continued downward on posterior surface about halfway; broad spot on posterior and dorsal surfaces of lateral angles of propodeum; widely separated lateral spots on tergites 1-4, decreasing in size from one to four; spot on distal end of middle femur; anterior border of middle tibia; anterior border of anterior tibia and metatarsus; and basal part of apical segment of anterior tarsus; *yellow*.

The pubescence is short and sparse, being longest on the vertex and upper part of the frons. The antennae show no special markings or modifications. The second sternite bears a small sharp-pointed but prominent median tooth. The wedgelike edge of the lateral angle of the propodeum shows, slightly above its middle point, a small toothlike prominence. The wings are hyaline.

Although this form differs from *quinquemaculata* in having the wings hyaline instead of infumated, in having only four of the tergites maculated instead of five, and in having a prominent tooth on the second sternite; nevertheless, further collecting and study may prove that it is only a regional variety of that species. However, with only these two specimens before me it seems to me best to regard them as representatives of two distinct species.

Length 17 mm. Described from a single male taken at Chapada, Brazil.

*Type*.—In the Carnegie Museum at Pittsburgh, Pa.

**BICYRTES INSIDIATRIX (Handlirsch)**

Figure 46

*Bembidula insidiatrix* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat.

Cl., vol. 98, 1889, p. 491.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 495.

*Bicyrtes insidiatrix* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 71.

This species seems most closely related to the following species (*capnoptera*), with which it shares a tendency toward ferruginous markings. There is no tooth on the posterior coxa, the female lacks a pygidial area and lateral ridges on the sixth tergite, and the male lacks the tooth on the posterior proximal edge of the intermediate femur. The legs are wholly ferruginous.

## SPECIMENS EXAMINED

NEW MEXICO.

TEXAS: Clarendon (August 11, 1905, C. R. Jones); Jacksonville (June 28, 1906, F. C. Bishopp); Mineola (June 26, 1906, F. C. Bishopp); Rosser (August 23, 1905, C. R. Jones).

Handlirsch reports the species also from Kentucky.

**BICYRTES TRISTIS C. L. Fox***Bicyrtes tristis* C. L. Fox, Proc. Cal. Acad. Sci., vol. 12, 1923, p. 435.

This species was described from a single male taken at La Paz, Lower California. It is closely related to *capnoptera* and *mesilensis*, from which species it may be distinguished by the lack of maculation on the metanotum, the narrower fasciae on the tergites, and by the form of the seventh tergite, which in this species is much narrowed at the apex.

**BICYRTES CAPNOPTERA (Handlirsch)***Bembidula capnoptera* HANDLIRSCH, Sitz. Akad. Wissensch. Wien, Math.-Nat.

Cl., vol. 98, 1889, p. 497.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 495.

*Bicyrtes capnoptera* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 72.

The wings of this species are infumated, very heavily in the case of some specimens, much less so in the case of others. The female bears a well-marked pygidial area on the sixth tergite set off by distinct lateral ridges, the apical part of the area being somewhat rugose. The male shows no structural modifications of legs or antennae that may serve to distinguish it from the males of other species.

## SPECIMENS EXAMINED

GEORGIA: Bainbridge (September 17–October 10, 1910, J. C. Bradley); Billy's Island, Okefenokee Swamp (June, 1912).

LOUISIANA: Mansfield (August 22, 1906, F. C. Bishopp).

TEXAS: Barstow (July 22, J. C. Crawford); Dallas (July 31, 1906, W. D. Pierce); Hearne (July 23, 1906, F. C. Bishopp); Marfa (June 5, 1908, Mitchell and Cushman); Mineola (July 23, 1906, F. C. Bishopp).

Handlirsch reports this species also from Kentucky.

**BICYRTE MESILLENIS (Cockerell)**

*Bembidula capnoptera* HANDLIRSCH, var. *mesillensis* COCKERELL, Davenport Acad. Nat. Sci., vol. 7, 1898, p. 142, male.

*Bembidula mesillensis* COCKERELL, Can. Ent., 1899, p. 255, female.

*Bicyrtes mesillensis* PARKER, Proc. U. S. Nat. Mus., vol. 52, 1917, p. 73.

In the collection of the United States National Museum are to be found two specimens of *Bicyrtes*, a male and a female, bearing labels that point to these two specimens as the ones on which Cockerell based his description of this species. In my previous paper (cited in the synonymy given above) I called attention to the divergent relationships of the male and female that had been associated as sexes of this species and raised the question of the validity of this association. Since then I have examined a large number of *Bicyrtes*, including both male and female specimens, in the collection of the California Academy of Sciences, taken at the same time at Pepper Sauce Canyon, Ariz., all of which I am convinced belong to a single species. The females in this number I regard as belonging to the same species as the female that Cockerell described as the female of *mesillensis*, but the males of this number do not belong to the species represented by the male on which *mesillensis* was based. It is my opinion that this group taken at Pepper Sauce Canyon represents either a regional variety of *ventralis* or possibly a new species and that the female assigned by Cockerell to *mesillensis* belongs with them, while the female of *mesillensis* still remains to be discovered.

NEW MEXICO: Las Cruces (Cockerell) male; Organ Mountains (Townsend) female.

**BICYRTE BRADLEYI, new species**

Figures 41, 42

*Type* (female).—Black: labrum; clypeus; scape below; lower part of frons continued upward from between the antennae by a narrow line to unite with spot below anterior ocellus; broad anterior orbits not reaching above level of anterior ocellus; posterior orbits narrowed both above and below; posterior border of pronotum including tubercles; spot on side of prothorax; broad lateral lines and pair of narrow, elliptical discal lines on scutum; fascia on posterior border of scutellum narrowed medially and narrowly interrupted at midline; metanotum; curved fascia on propodeum; lateral angles and sides of propodeum; large anterior and small posterior spot on mesopleura;

broad fasciae on tergites 1-5 all narrowly interrupted at midline, the first broadest and narrowed abruptly at the midline, the remainder slightly sinuate on either side the midline; large median spot on sixth tergite; lateral spots on sternites 2-4, decreasing in size from two to four; pair of small spots on anterior coxae; femora in part; tibiae except line below; and tarsi, *pale creamy yellow*. The tarsi are dark, almost ferruginous in color, and the maculations of the tibiae and femora are a richer yellow than those on the body.

This species differs from a typical species of the genus in that, although the propodeum is concave on its posterior surface, the degree of concavity is less than normal, and, furthermore, the posterior-lateral angles, although prominent, are rounded instead of being drawn out into sharp, wedgelike edges. It is further distinguished by the fact that, although the specimen is a female, the second sternite bears a pair of small sharp-pointed processes, which are the posterior ends of a U-shaped ridge on the sternite. The intermediate coxa bears a small tooth. The sixth tergite, which bears a well-defined, heart-shaped pygidial area, ends in a sharp point, while the broad apical end of the sixth sternite extends laterally on either side the tergite (fig. 41) in a fashion characteristic of this species.

The mandibles and the flagella are black. The wings are almost hyaline. The pubescence on head and thorax is white, very fine, and very short. The puncturing of the scutum and scutellum is uniform, very fine, and very close, much finer and closer than in the case of *variegata* or *discisa*, with which species it has been compared. It is a very unusual species.

Length 14 mm. Described from a single female collected March, 1920, at Pie de Palo, San Juan, Argentina, South America, by J. Chester Bradley, for whom the species is named.

*Type* (female).—In the collection of Cornell University.

#### BICYRTE PEXA, new species

*Type* (female).—Black: labrum; base of mandibles; clypeus, except large triangular blotch at base; scape below; small spot between antennae; broad, but short, anterior orbits; posterior orbits very narrow above; broken fascia on posterior border of pronotum; posterior border on tubercles; spot on tagulae; spot on base of anterior wings; short, lateral lines on scutum at base of wings; small, rounded lateral spots on scutellum; narrow, arcuate fascia on dorsum of propodeum; broad spot on its lateral angles; small spot near base of wings on mesopleura; interrupted fasciae on tergites 1-5, with width of interruption increasing from first to fifth, and all fasciae narrowed toward the middorsal line, except the fifth; small lateral spots on sixth; lateral spots on sternites 2-4; spot on coxae;

femora in part; anterior surface of tibiae; and tarsi more or less; *pale yellow*.

The pubescence is inconspicuous, though the labrum and the basal segments of the legs show a slight silveriness. The flagellum is black. The dorsum of the thorax, especially the scutellum, shows a beautiful metallic iridescence. In color the maculations of the head are a greenish yellow, of the body pale, and of the legs rich yellow. On the front legs all segments of the tarsus are marked with yellow, on the second pair only the first and last segments, and on the third pair only the metatarsus. The wings are almost hyaline, showing only very slight uniform infumation. The sixth tergite bears a pygidial area set off by weak, lateral lines or ridges. The middle part of the pygidial area is devoid of punctures and its lateral areas are covered with coarse, rather widely separated punctures. The areas laterad of the ridges are covered with fine, closely-placed punctures. The sixth sternite, which extends laterad of the sixth tergite much as is the case with *B. capnoptera* Handlirsch, is distinctly carinate on the midline and is finely punctulate with a few scattered coarser punctures.

Length 15 mm. The species is described from a single female from Cayenne, South America.

*Type* (female).—In the Carnegie Museum at Pittsburgh, Pa.

#### BICYRTE ANGULATA (Smith)

*Monedula angulata* SMITH, Cat. Hym. Brit. Mus., vol. 4, 1856, p. 334.

*Bembidula angulata* HANDLIRSCH, Sitz. Akad. Wissensch. Wien. Math.-Nat. Cl., vol. 98, 1889, p. 480.—DALLA TORRE, Cat. Hym., vol. 8, 1897, p. 494.

I have before me three females that I have referred to this species, which differs from all other species in the genus in having the dorsal angle of the posterior-lateral margin of the propodeum drawn out into a point. The fasciae on both tergites and sternites are usually broad and continuous, but on one of the three females at hand the fasciae on tergites 1-3 are very narrowly interrupted. The legs are almost wholly ferruginous and the wings are slightly and uniformly infumated.

#### SPECIMENS EXAMINED

BRAZIL: Pernambuco (January 1, 1883).

PARAGUAY: Sapucay (April 8, 1903, W. T. Foster).

Handlirsch reports this species also from Cayenne.

#### BICYRTE SOLA, new species

*Type* (female).—Black: labrum; mandibles, except tips; clypeus; lower part of frons; antenna, except last four segments; orbits; line

on pronotum; tubercles; tegulae; lateral line on scutum above tegula; pair of small discal spots on scutum; curved fascia on posterior border of scutellum; fascia on metanotum; curved fascia on dorsum of propodeum extended in two points on posterior surface; lateral angles of propodeum; three spots in vertical line on mesopleura; broad fasciae on tergites 1-5, interrupted medially on 1-4, much narrowed toward interruption on first tergite, less so on tergites 2-4, broad, continuous fascia on 5; sixth tergite entirely; narrow, apical fascia on first sternite; large, lateral spots on second sternite, joined by a narrow, apical fascia; broad fasciae on sternites 3-5, each enclosing a darker median area; sixth sternite entirely; and legs; *yellow* or *yellow and ferruginous*.

The markings on the abdomen and thorax are in the main rich yellow, but on all parts of the body there is a tendency toward ferruginous. The combination of yellow and ferruginous is best seen on the clypeus and on the legs, the basal parts being ferruginous and the distal parts yellow. The scape is yellow below, ferruginous above. The flagellum is ferruginous, growing darker toward the distal end, where the last four segments are black, except that the ultimate segment is tipped with ferruginous. The clypeus and frons are covered with short, silvery pubescence. On mesopleura the pubescence is white and somewhat longer. Elsewhere pubescence is practically wanting. The wings are without infumation. The punctures on the scutum and scutellum are somewhat coarse and uniform in distribution. The sixth tergite lacks a pygidial area and lateral ridges.

Length 18 mm. Described from a single female from Chapada, Brazil.

*Type* (female).—In the Carnegie Museum at Pittsburgh, Pa.

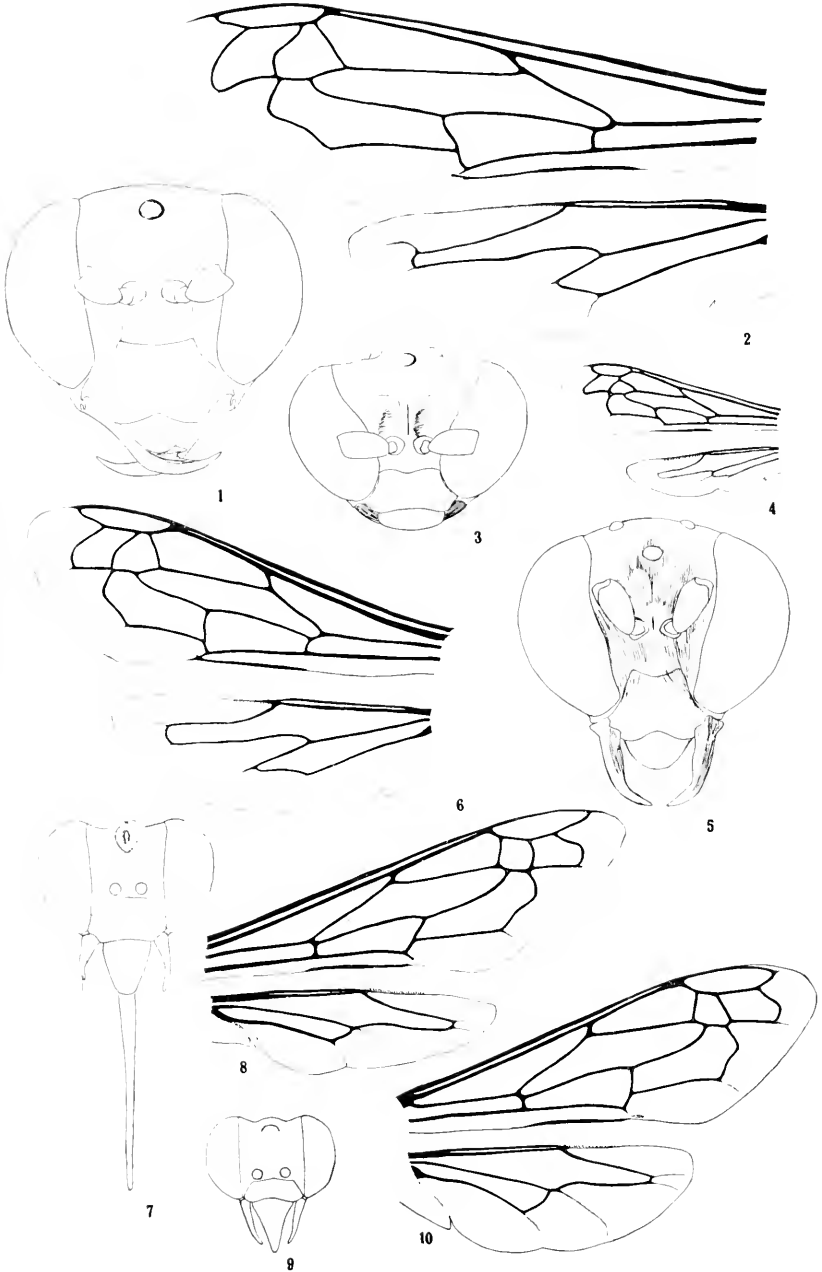
#### EXPLANATION OF PLATES

The figures of the wings were made from projections of the wings mounted in balsam under cover glasses, and are therefore exact in outline and proportions. The degree of magnification in the projections was approximately the same for all wings, so that the relative sizes of the figures show the relative sizes of the wings of the species selected as illustrations. All other figures are camera lucida drawings made directly from the parts illustrated, but the scale of magnification is not uniform so that the sizes of the figures do not show the relative sizes of the parts illustrated. In the case of the males the specimens were relaxed and the genitalia were then removed, mounted on paper points, and permitted to dry. All figures of male genitalia were made from such mounts; no balsam mounts of genitalia were used. In assembling the figures on the several plates the author has endeavored to group them together in such manner as will render them most helpful in the determination of species of these wasps.

PLATE 1

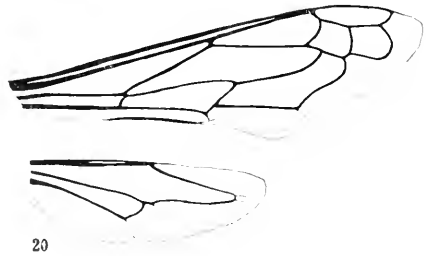
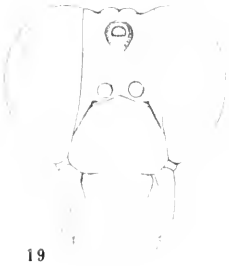
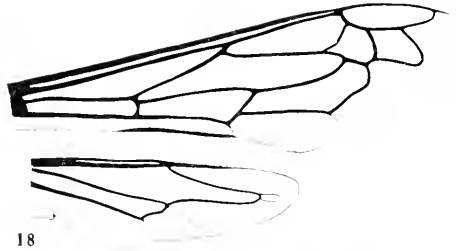
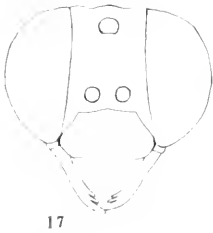
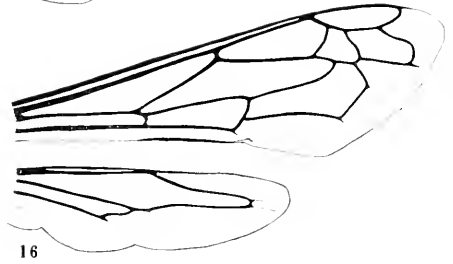
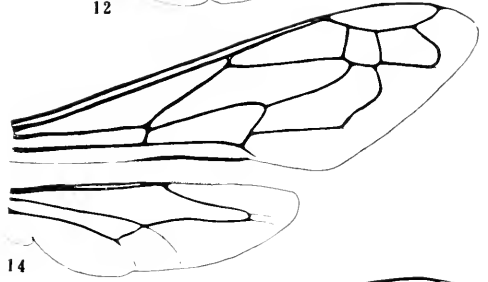
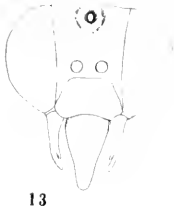
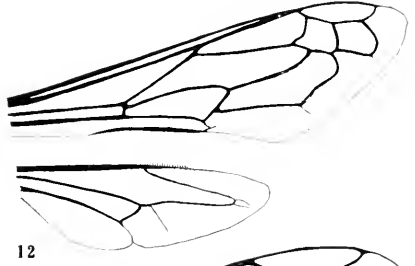
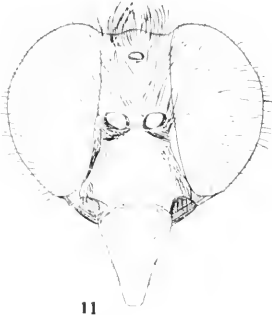
- FIG. 1. *Stizus ruficornis* (Fabricius). Head, front view.  
2. *Stizus texanus* Cresson. Wings.  
3. *Bembicinus tridens* (Fabricius). Head, front view.  
4. *Bembicinus godmani* (Cameron). Wings.  
5. *Stizoides tridentatus* (Fabricius). Head, front view.  
6. *Stizoides tridentatus* (Fabricius). Wings.  
7. *Steniolia duplicata* Provancher. Head, front view.  
8. *Steniolia duplicata* Provancher. Wings.  
9. *Microbembeæ monodonta* Say. Head, front view.  
10. *Microbembeæ monodonta* Say. Wings.





FOSSORIAL WASPS OF STIZINI AND BEMBICINI

FOR EXPLANATION OF PLATE SEE PAGE 182



FOSSORIAL WASPS OF STIZINI AND BEMBICINI

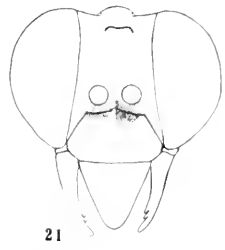
FOR EXPLANATION OF PLATE SEE PAGE 183

PLATE 2

- FIG. 11. *Trichostictia vulpina* (Handlirsch). Head, front view.  
12. *Trichostictia vulpina* (Handlirsch). Wings.  
13. *Stictiella pulchella* (Cresson). Head, front view.  
14. *Stictiella scitula* (Fox). Wings.  
15. *Bicyrtes quadrifasciata* (Say). Head, front view.  
16. *Bicyrtes ventralis* (Say). Wings.  
17. *Selman angustus* Parker. Head, front view.  
18. *Selman angustus* Parker. Wings.  
19. *Therapon chilensis* (Eschscholz). Head, front view.  
20. *Therapon chilensis* (Eschscholz). Wings.

PLATE 3

- FIG. 21. *Rubrica grvida* (Handlirsch). Head, front view.  
22. *Rubrica grvida* (Handlirsch). Wings.  
23. *Stictia signata* (Fabricius). Head, front view.  
24. *Stictia carolina* (Fabricius). Wings.  
25. *Editha magnifica* (Perty). Head, front view.  
26. *Editha magnifica* (Perty). Wings.

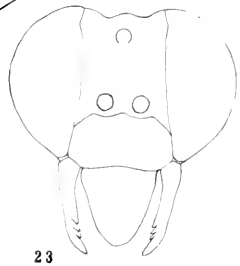


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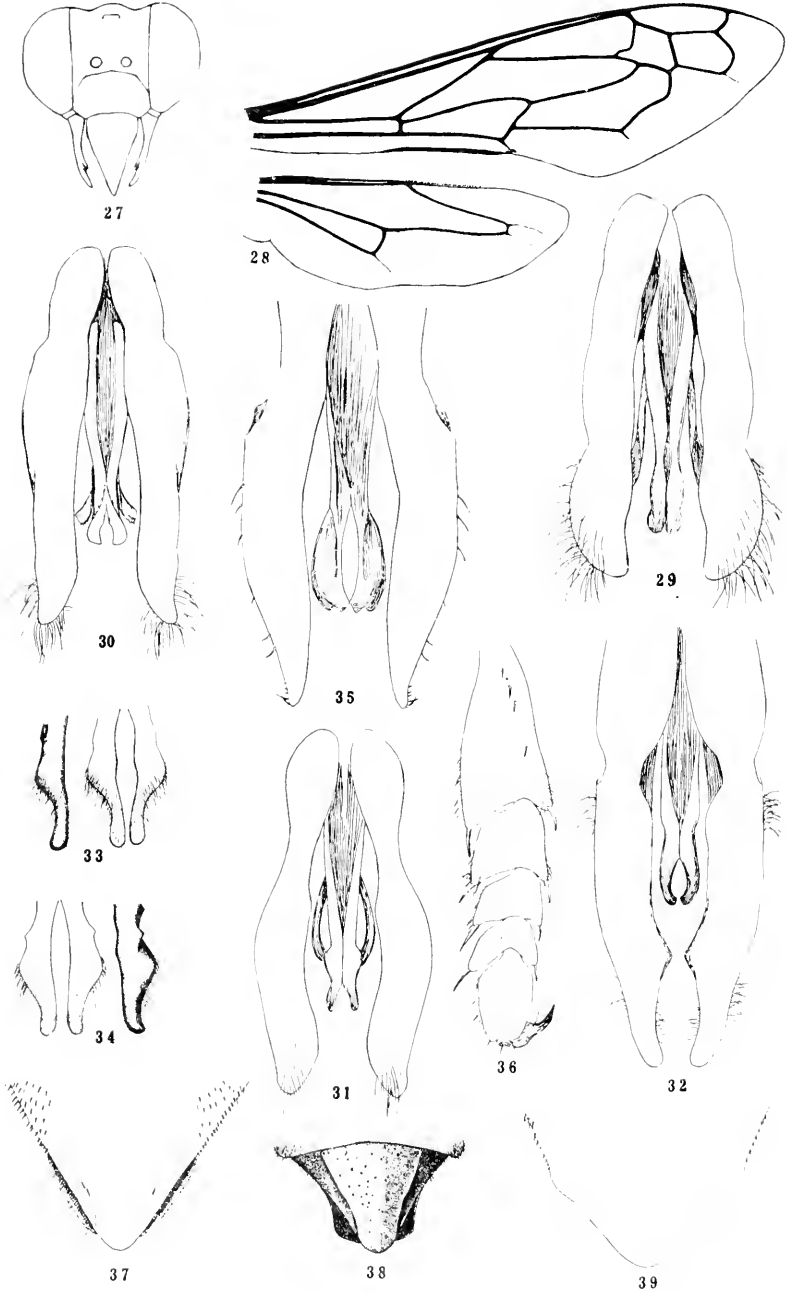


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FOSSORIAL WASPS OF STIZINI AND BEMBICINI

FOR EXPLANATION OF PLATE SEE PAGE 184



FOSSORIAL WASPS OF STIZINI AND BEMBICINI

FOR EXPLANATION OF PLATE SEE PAGE 185

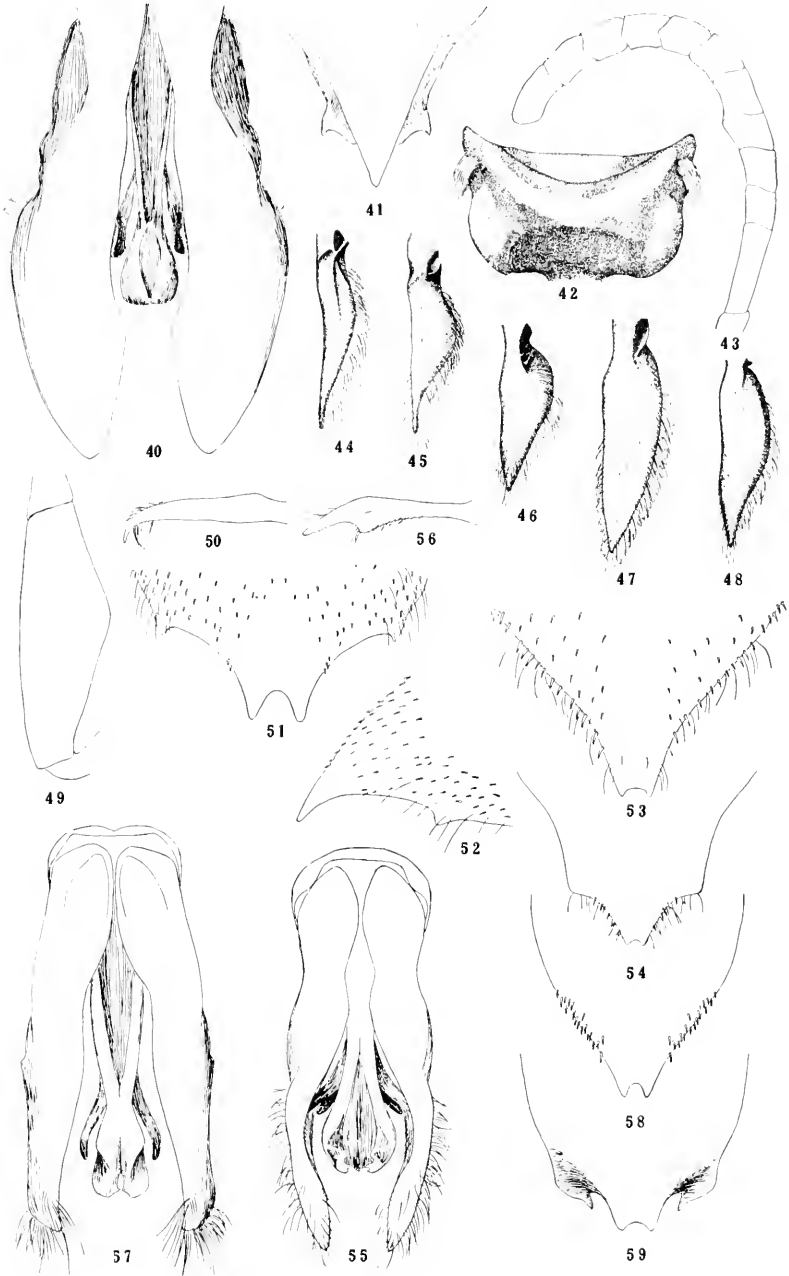
PLATE 4

- FIG. 27. *Bembix spinolae* Lepeletier. Head, front view.  
28. *Bembix similans* Fox. Wings.  
29. *Stizus occidentalis* Parker. Genitalia, male.  
30. *Stizoides tridentatus* (Fabricius). Genitalia, male.  
31. *Steniolia longirostris* Say. Genitalia, male.  
32. *Stictiella formosa* Cresson. Genitalia, male.  
33. *Stictiella femorata* Fox. Genital stipites, male.  
34. *Stictiella divergens* Parker. Genital stipites, male.  
35. *Bicyrtes quinquemaculata* Parker. Genitalia, male.  
36. *Bicyrtes odontophora* (Handlirsch). Anterior tarsus, male.  
37. *Bicyrtes spinosa* (Fabricius). Sixth tergite, female.  
38. *Bicyrtes fodiens* (Handlirsch). Sixth tergite, female.  
39. *Bicyrtes spinosa* (Fabricius). Seventh tergite, male.

PLATE 5

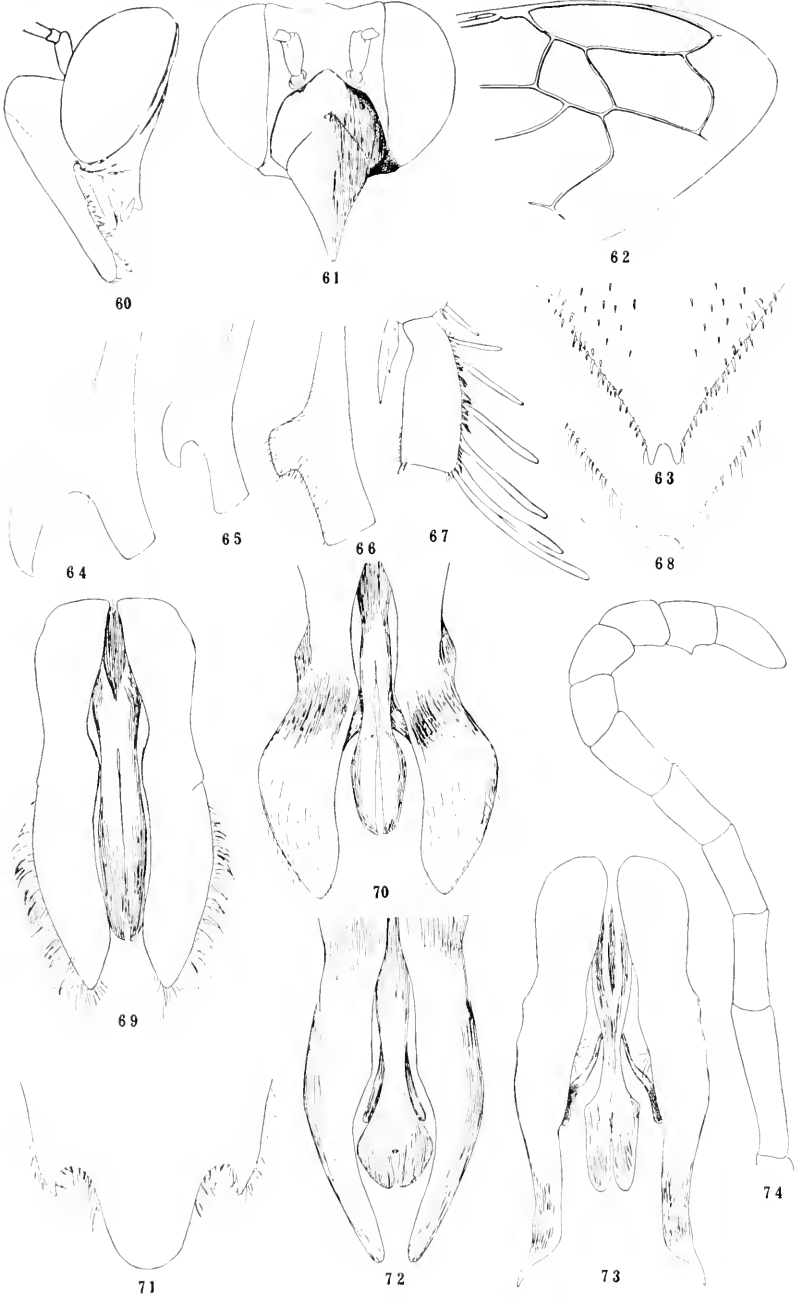
- FIG. 40. *Bicyrtes tricolorata* Parker. Genitalia, male.  
41. *Bicyrtes bradleyi* Parker. Sixth tergite, female.  
42. *Bicyrtes bradleyi* Parker. Propodeum, dorso-posterior view, female.  
43. *Bicyrtes discisa* (Taschenberg). Flagellum, male.  
44. *Bicyrtes quadrifasciata* (Say). Genital stipes, male.  
45. *Bicyrtes variegata* (Olivier). Genital stipes, male.  
46. *Bicyrtes insidiatrix* (Handlirsch). Genital stipes, male.  
47. *Bicyrtes viduata* (Handlirsch). Genital stipes, male.  
48. *Bicyrtes gracilis* Parker. Genital stipes, male.  
49. *Microbembex sulphurea* (Spinola). Posterior femur, male.  
50. *Microbembex sulphurea* (Spinola). Spine of eighth sternite, latero-ventral view, male.  
51. *Microbembex natalis* Parker. Sixth tergite, dorso-posterior view, female.  
52. *Microbembex natalis* Parker. Sixth tergite, lateral view, female.  
53. *Microbembex tricososa* Parker. Sixth tergite, dorsal view, female.  
54. *Microbembex tricososa* Parker. Seventh tergite, dorsal view, male.  
55. *Microbembex tricososa* Parker. Genitalia, male.  
56. *Microbembex bidens* Parker. Spine of eighth sternite, lateral view, male.  
57. *Microbembex bidens* Parker. Genitalia, male.  
58. *Microbembex bidens* Parker. Sixth tergite, female.  
59. *Microbembex bidens* Parker. Seventh tergite, male.





FOSSORIAL WASPS OF STIZINI AND BEMBICINI

FOR EXPLANATION OF PLATE SEE PAGE 186



FOSSORIAL WASPS OF STIZINI AND BEMBICINI

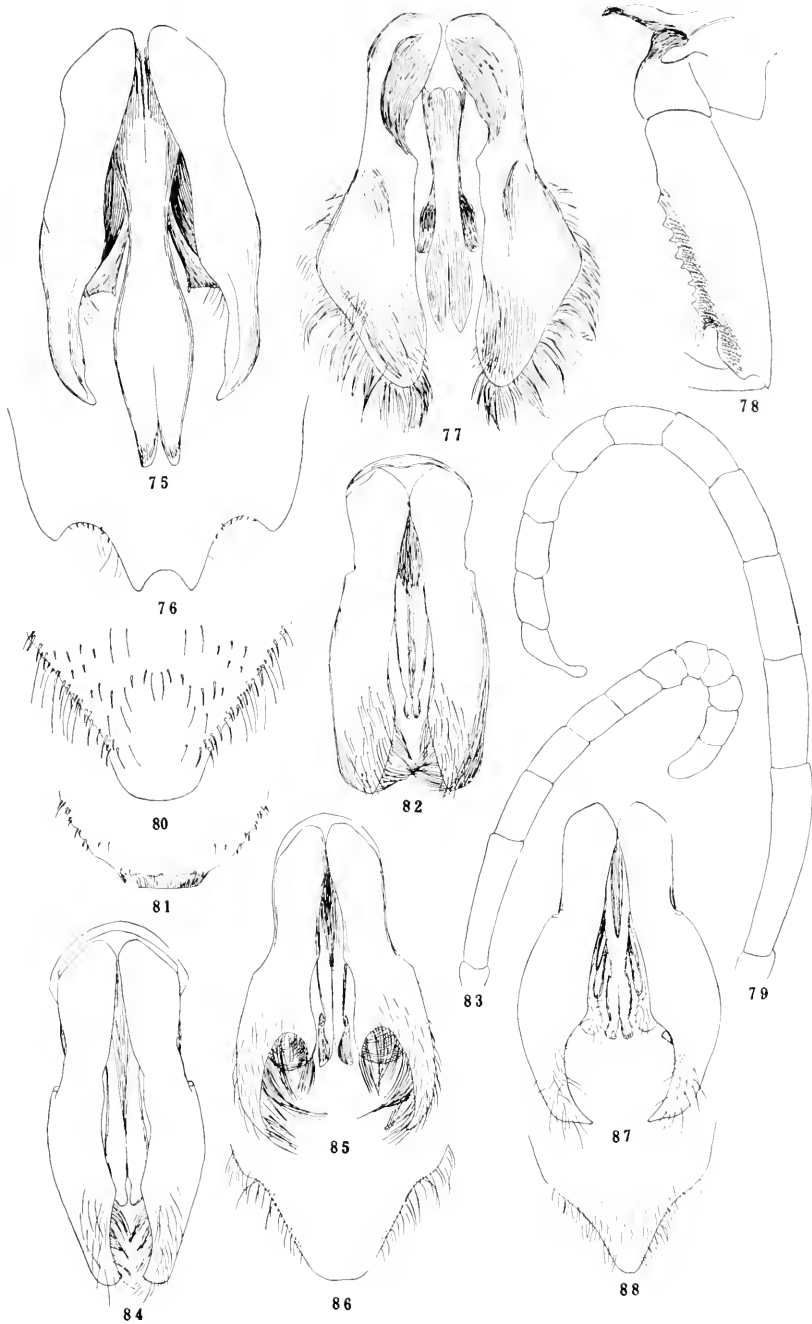
FOR EXPLANATION OF PLATE SEE PAGE 187

PLATE 6

- FIG. 60. *Microbembex nasuta* Parker. Head, lateral view, female.  
61. *Microbembex nasuta* Parker. Head, front view, female.  
62. *Microbembex equalis* Parker. Second cubital cell, female.  
63. *Microbembex equalis* Parker. Sixth tergite, female.  
64. *Microbembex aurata* Parker. Process on second sternite, male.  
65. *Microbembex monodonta* (Say). Process on second sternite, male.  
66. *Microbembex hirsuta* Parker. Process on second sternite, male.  
67. *Microbembex nasuta* Parker. Anterior metatarsus, female.  
68. *Microbembex nasuta* Parker. Sixth tergite, female.  
69. *Trichostictia vulpina* (Handlirsch). Genitalia, male.  
70. *Trichostictia guttata* (Taschenberg). Genitalia, male.  
71. *Trichostictia vulpina* (Handlirsch). Seventh tergite, male.  
72. *Stictia trifasciata* Parker. Genitalia, male.  
73. *Rubrica surinamensis* (Degeer). Genitalia, male.  
74. *Stictia mexicana* (Handlirsch). Flagellum, female.

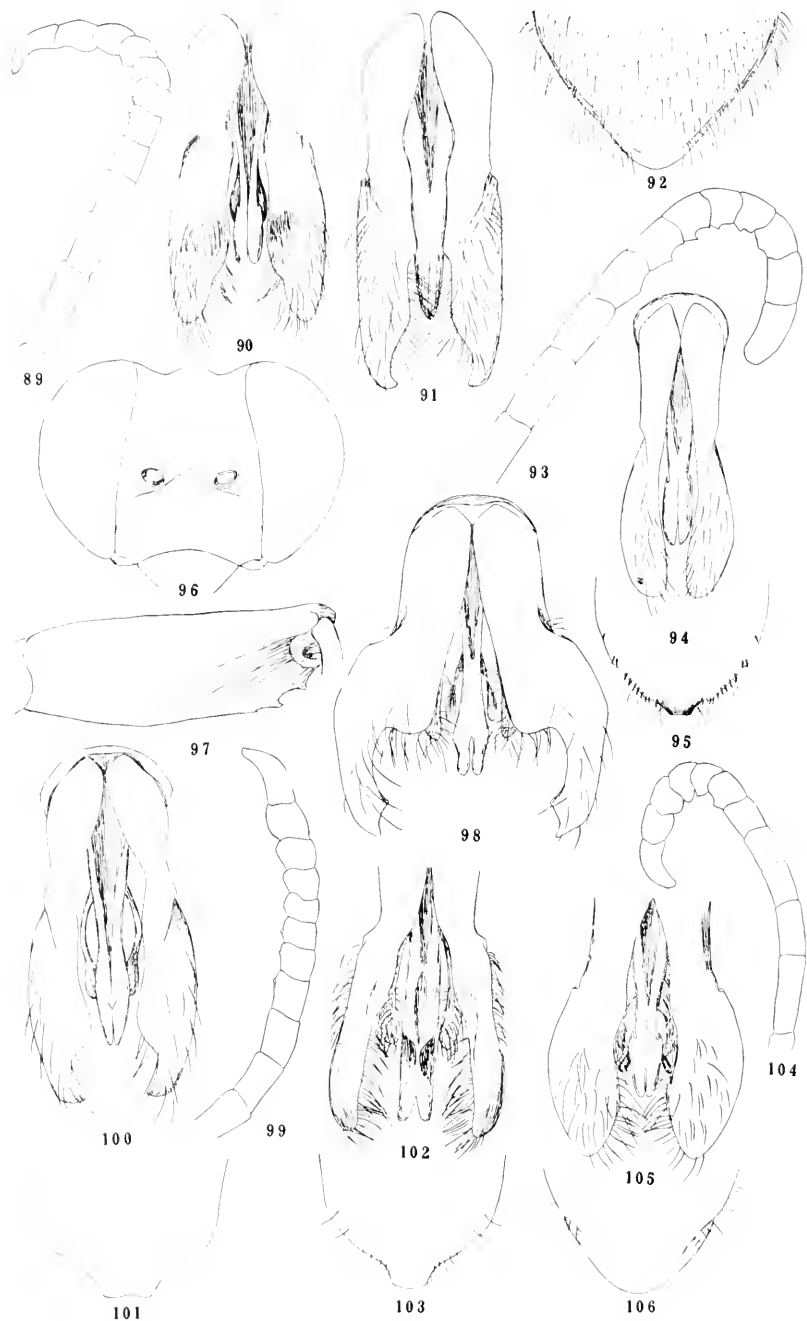
PLATE 7

- FIG. 75. *Editha magnifica* (Perty). Genitalia, male.  
76. *Therapon chilensis* (Eschscholz). Seventh tergite, male.  
77. *Therapon chilensis* (Eschscholz). Genitalia, male.  
78. *Therapon chilensis* (Eschscholz). Basal segments of middle leg, male.  
79. *Therapon chilensis* (Eschscholz). Flagellum, male.  
80. *Bembix agrestis* Parker. Sixth tergite, female.  
81. *Bembix agrestis* Parker. Seventh tergite, male.  
82. *Bembix agrestis* Parker. Genitalia, male.  
83. *Bembix aldabra* Parker. Flagellum, male.  
84. *Bembix aldabra* Parker. Genitalia, male.  
85. *Bembix albata* Parker. Genitalia, male.  
86. *Bembix albata* Parker. Seventh tergite, male.  
87. *Bembix alacris* Parker. Genitalia, male.  
88. *Bembix alacris* Parker. Seventh tergite, male.



FOSSORIAL WASPS OF STIZINI AND BEMBICINI

FOR EXPLANATION OF PLATE SEE PAGE 188



FOSSORIAL WASPS OF STIZINI AND BEMBICINI

FOR EXPLANATION OF PLATE SEE PAGE 189

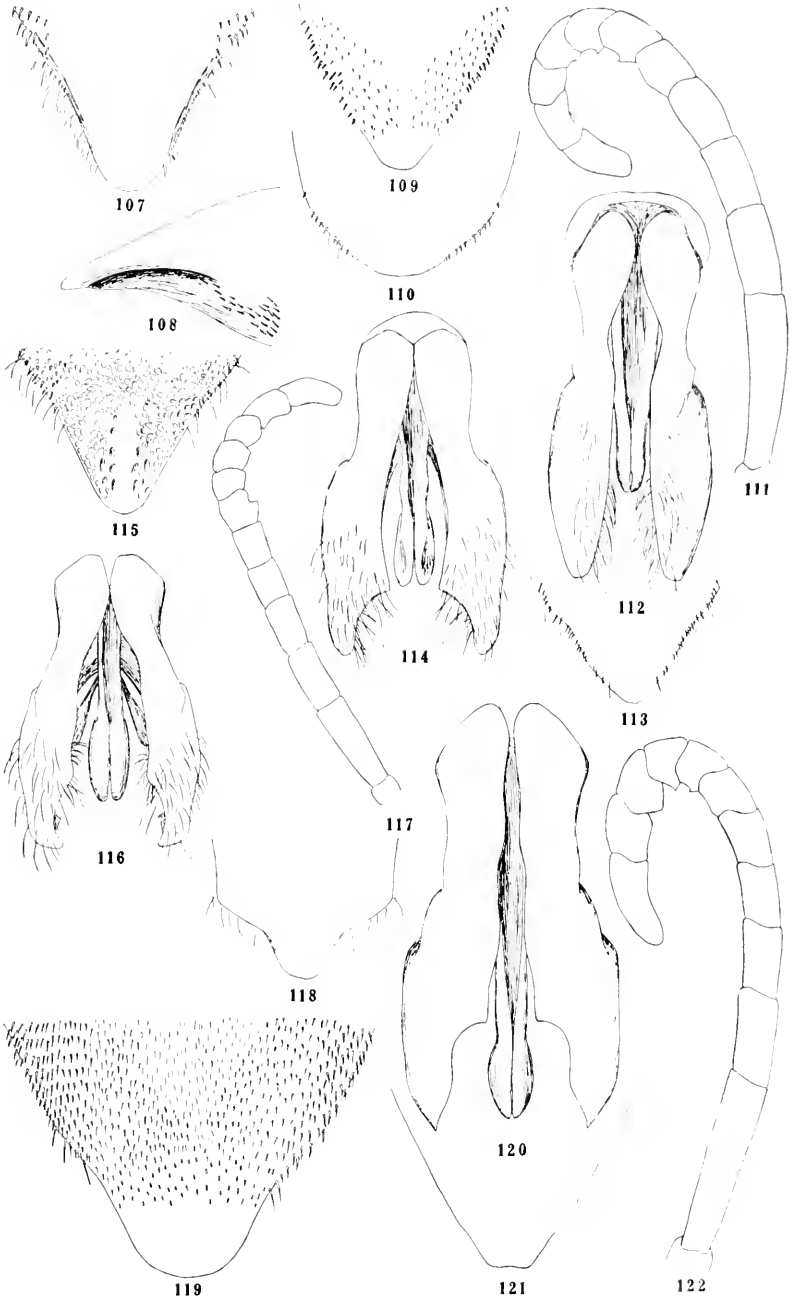
PLATE 8

- FIG. 89. *Bembix alacris* Parker. Flagellum, male.  
90. *Bembix bahiae* Parker. Genitalia, male.  
91. *Bembix festiva* Parker. Genitalia, male.  
92. *Bembix festiva* Parker. Seventh tergite, male.  
93. *Bembix festiva* Parker. Flagellum (apical segments), male.  
94. *Bembix flavolatera* Parker. Genitalia, male.  
95. *Bembix flavolatera* Parker. Seventh tergite, male.  
96. *Bembix bellatrix* Parker. Clypeus and frons, female.  
97. *Bembix forcipata* Handlirsch. Middle femur, male.  
98. *Bembix forcipata* Handlirsch. Genitalia, male.  
99. *Bembix forcipata* Handlirsch. Flagellum (apical part), male.  
100. *Bembix frioensis* Parker. Genitalia, male.  
101. *Bembix frioensis* Parker. Seventh tergite, male.  
102. *Bembix fumida* Parker. Genitalia, male.  
103. *Bembix fumida* Parker. Seventh tergite, male.  
104. *Bembix fucosa* Parker. Flagellum, male.  
105. *Bembix fucosa* Parker. Genitalia, male.  
106. *Bembix fucosa* Parker. Seventh tergite, male.

PLATE 9

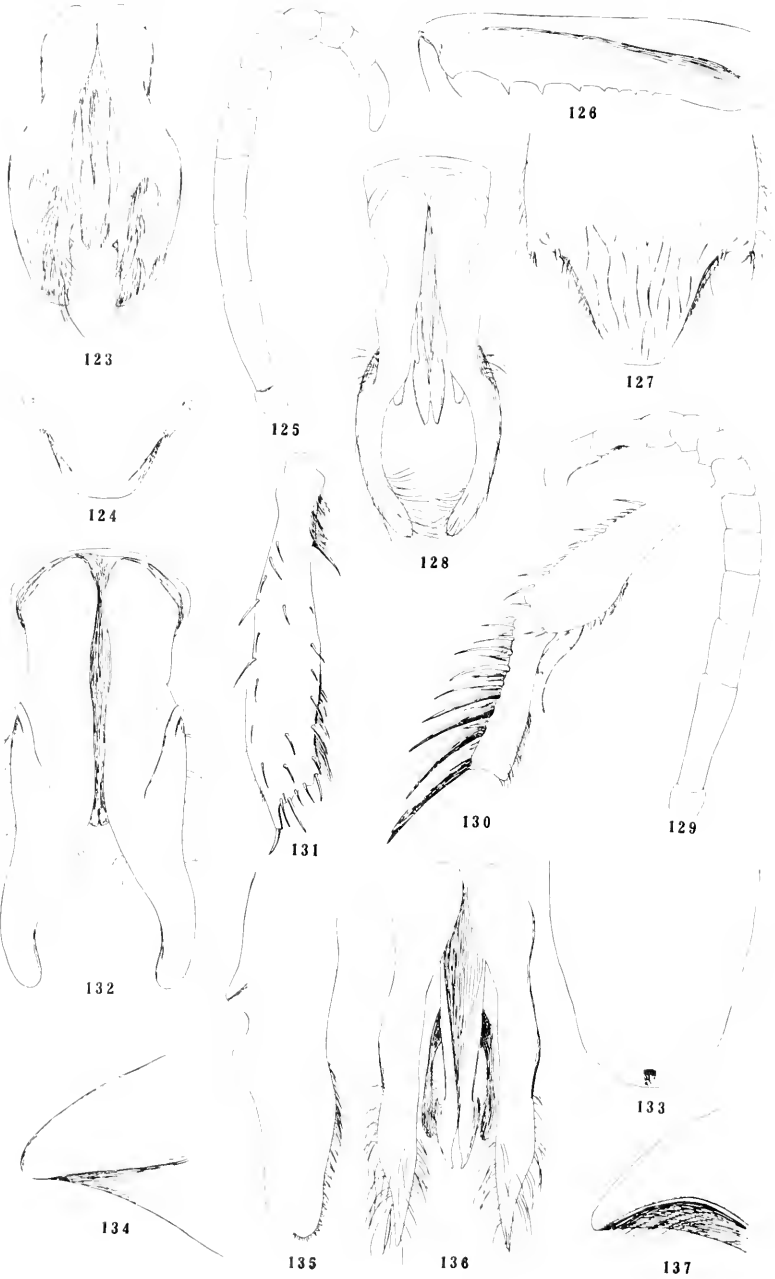
- FIG. 107. *Bembix generosa* Parker. Sixth tergite, dorsal view, female.  
108. *Bembix generosa* Parker. Sixth tergite, lateral view, female.  
109. *Bembix gracilens* Parker. Sixth tergite, female.  
110. *Bembix hamata* C. L. Fox. Seventh tergite, male.  
111. *Bembix hamata* C. L. Fox. Flagellum, male.  
112. *Bembix hamata* C. L. Fox. Genitalia, male.  
113. *Bembix kreichbaumeri* Handlirsch. Seventh tergite, male.  
114. *Bembix kreichbaumeri* Handlirsch. Genitalia, male.  
115. *Bembix laeta* Parker. Sixth tergite, female.  
116. *Bembix levis* Parker. Genitalia, male.  
117. *Bembix levis* Parker. Flagellum, male.  
118. *Bembix levis* Parker. Seventh tergite, male.  
119. *Bembix liberiensis* Parker. Sixth tergite, female.  
120. *Bembix liberiensis* Parker. Genitalia, male.  
121. *Bembix liberiensis* Parker. Seventh tergite, male.  
122. *Bembix liberiensis* Parker. Flagellum, male.





FOSSORIAL WASPS OF STIZINI AND BEMBICINI

FOR EXPLANATION OF PLATE SEE PAGE 190



FOSSORIAL WASPS OF STIZINI AND BEMBINI

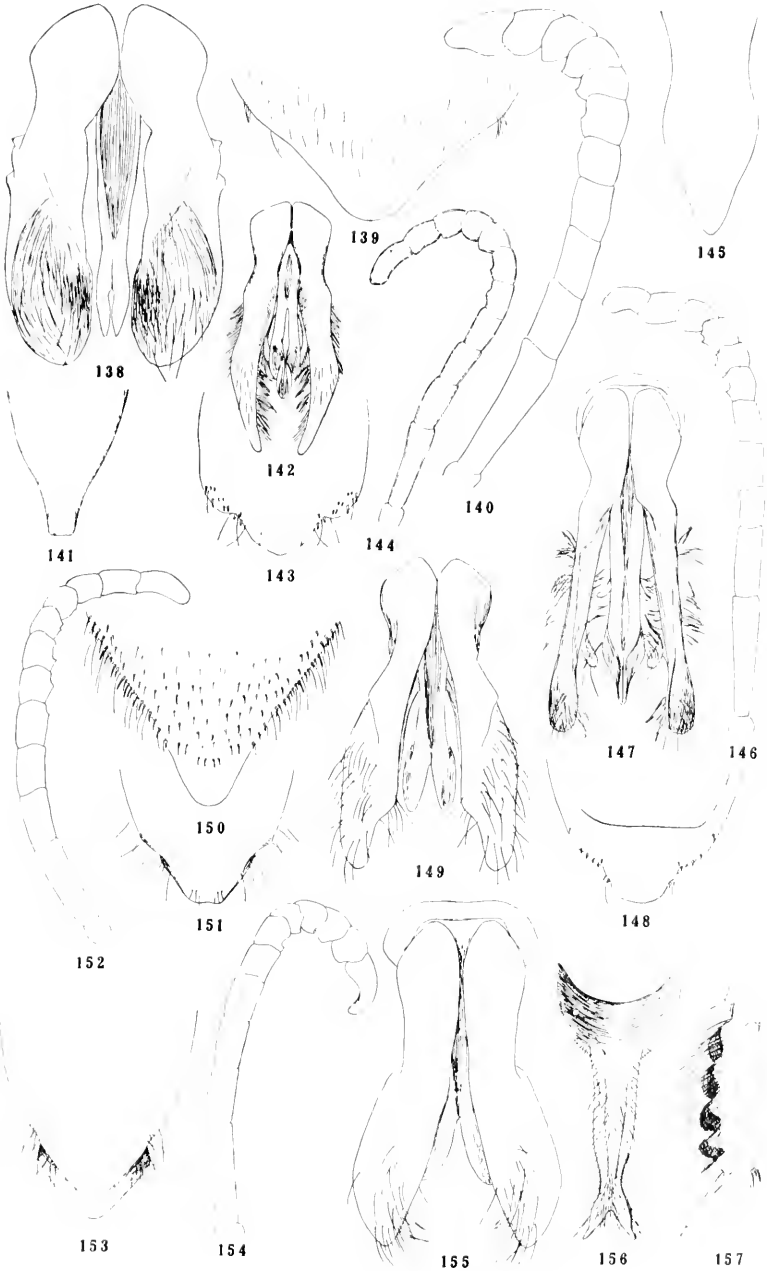
FOR EXPLANATION OF PLATE SEE PAGE 191

PLATE 10

- FIG. 123. *Bembix loupata* Parker. Genitalia, male.  
124. *Bembix loupata* Parker. Seventh tergite, male.  
125. *Bembix loupata* Parker. Flagellum, male.  
126. *Bembix loupata* Parker. Middle femur, male.  
127. *Bembix magdalena* C. L. Fox. Seventh tergite, male.  
128. *Bembix magdalena* C. L. Fox. Genitalia, male.  
129. *Bembix merceti* Parker. Flagellum, male.  
130. *Bembix merceti* Parker. Anterior tibia and metatarsus, male.  
131. *Bembix merceti* Parker. Middle tibia, male.  
132. *Bembix merceti* Parker. Genitalia, male.  
133. *Bembix merceti* Parker. Seventh tergite, male.  
134. *Bembix mima* Handlirsch. Sixth tergite, dorso-lateral view, female.  
135. *Bembix mima* Handlirsch. Labrum, lateral view, female.  
136. *Bembix mima* Handlirsch. Genitalia, male.  
137. *Bembix mima* Handlirsch. Seventh tergite, dorso-lateral view, male.

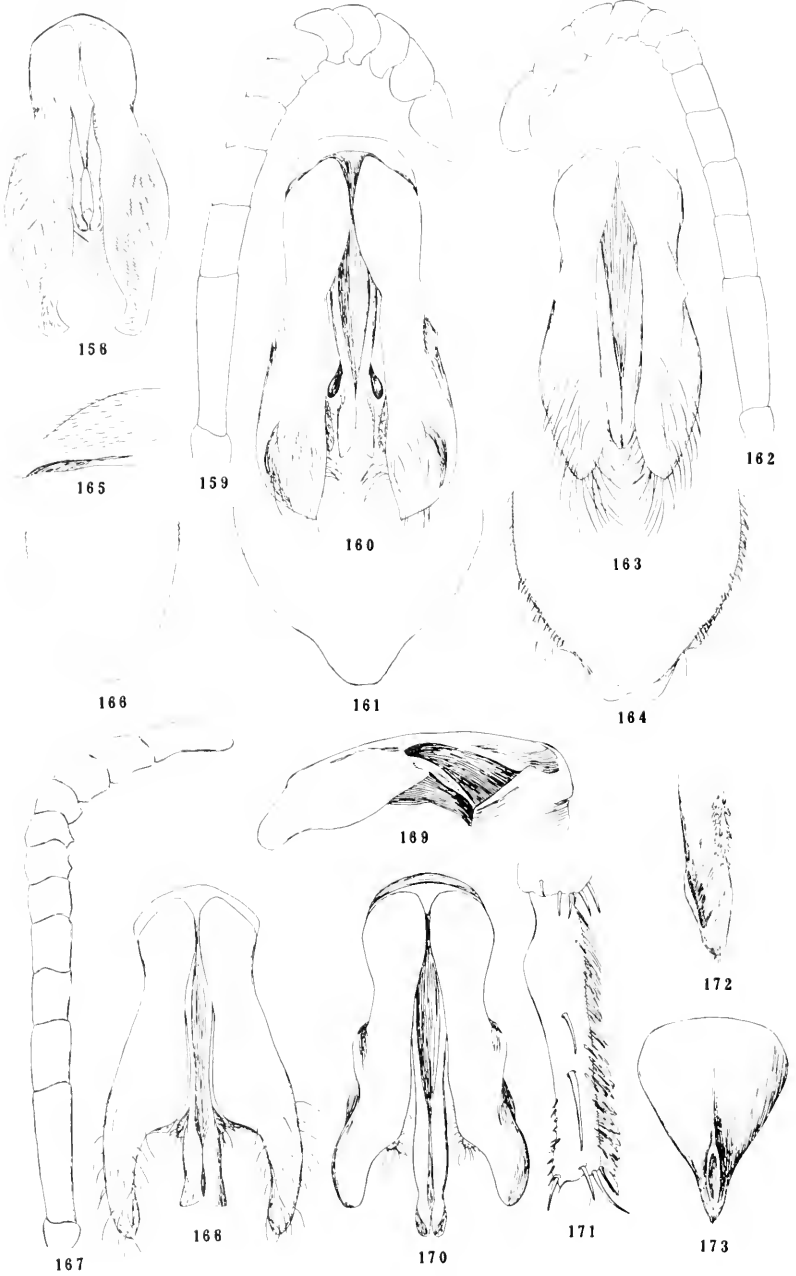
PLATE 11

- FIG. 138. *Bembix miserabilis* Parker. Genitalia, male.  
139. *Bembix miserabilis* Parker. Seventh tergite, male.  
140. *Bembix miserabilis* Parker. Flagellum, male.  
141. *Bembix nigrocornuta* Parker. Seventh sternite, ventral view, male  
142. *Bembix nigrocornuta* Parker. Genitalia, male.  
143. *Bembix nigrocornuta* Parker. Seventh tergite, male.  
144. *Bembix nigrocornuta* Parker. Flagellum, male.  
145. *Bembix niponica* Smith. Spine of eighth sternite, male.  
146. *Bembix ochracea* Handlirsch. Flagellum, male.  
147. *Bembix ochracea* Handlirsch. Genitalia, male.  
148. *Bembix ochracea* Handlirsch. Seventh tergite, male.  
149. *Bembix opinabilis* Parker. Genitalia, male.  
150. *Bembix opinabilis* Parker. Sixth tergite, female.  
151. *Bembix opinabilis* Parker. Seventh tergite, male.  
152. *Bembix opinabilis* Parker. Flagellum, male.  
153. *Bembix orientalis* Handlirsch. Seventh tergite, male.  
154. *Bembix orientalis* Handlirsch. Flagellum, male.  
155. *Bembix orientalis* Handlirsch. Genitalia, male.  
156. *Bembix persimilis* Turner. Spine eighth sternite, male.  
157. *Bembix persimilis* Turner. Anterior metatarsus, male.



FOSSORIAL WASPS OF STIZINI AND BEMBICINI

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FOSSORIAL WASPS OF STIZINI AND BEMBICINI

FOR EXPLANATION OF PLATE SEE PAGE 193

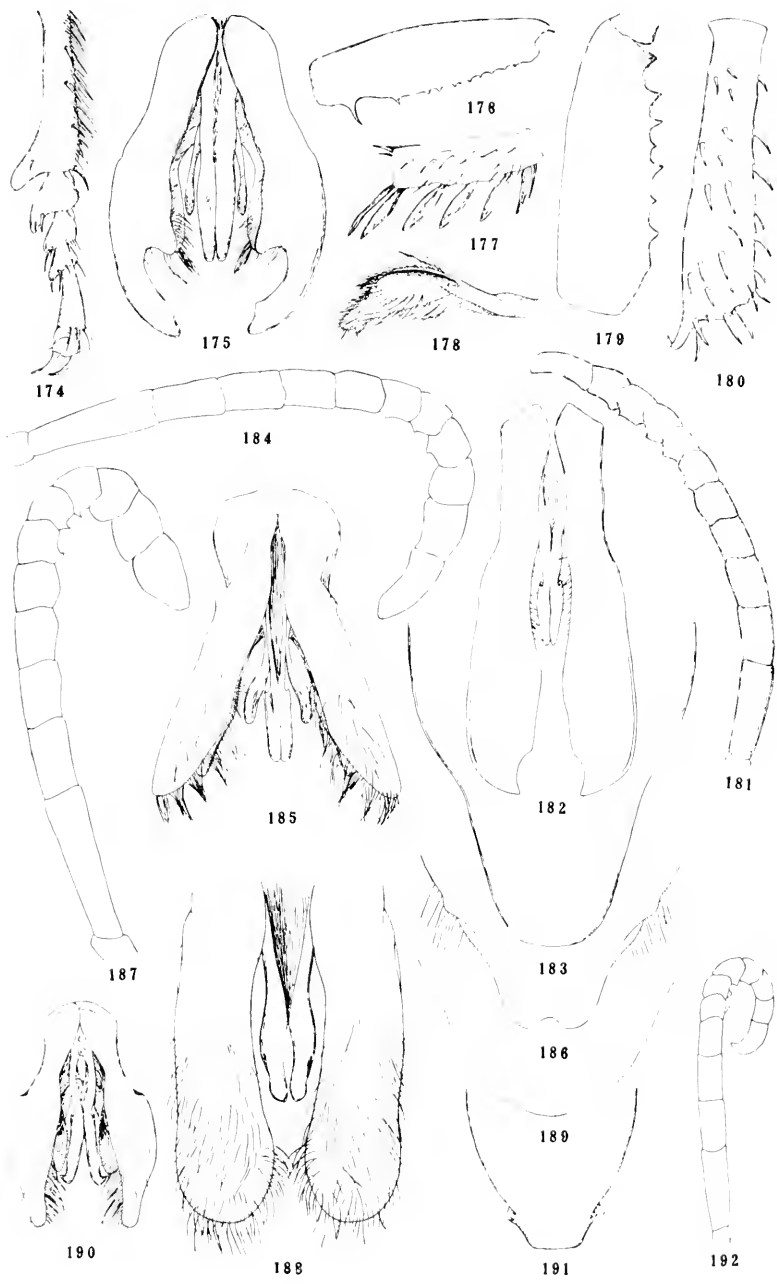
PLATE 12

- FIG. 158. *Bembix persimilis* Turner. Genitalia, male.  
159. *Bembix picticollis* Morawitz. Flagellum, male.  
160. *Bembix picticollis* Morawitz. Genitalia, male.  
161. *Bembix picticollis* Morawitz. Seventh tergite, male.  
162. *Bembix quinquespinosa* Parker. Flagellum, male.  
163. *Bembix quinquespinosa* Parker. Genitalia, male.  
164. *Bembix quinquespinosa* Parker. Seventh tergite, male.  
165. *Bembix recurva* Parker. Seventh tergite, lateral view, male.  
166. *Bembix recurva* Parker. Seventh tergite, dorsal view, male.  
167. *Bembix recurva* Parker. Flagellum, male.  
168. *Bembix recurva* Parker. Genitalia, male.  
169. *Bembix refuscata* Parker. Genital stipes, lateral view, male.  
170. *Bembix refuscata* Parker. Genitalia, male.  
171. *Bembix refuscata* Parker. Middle metatarsus, male.  
172. *Bembix regia* Parker. Labrum, lateral view, female.  
173. *Bembix regia* Parker. Labrum, front view, female.

PLATE 13

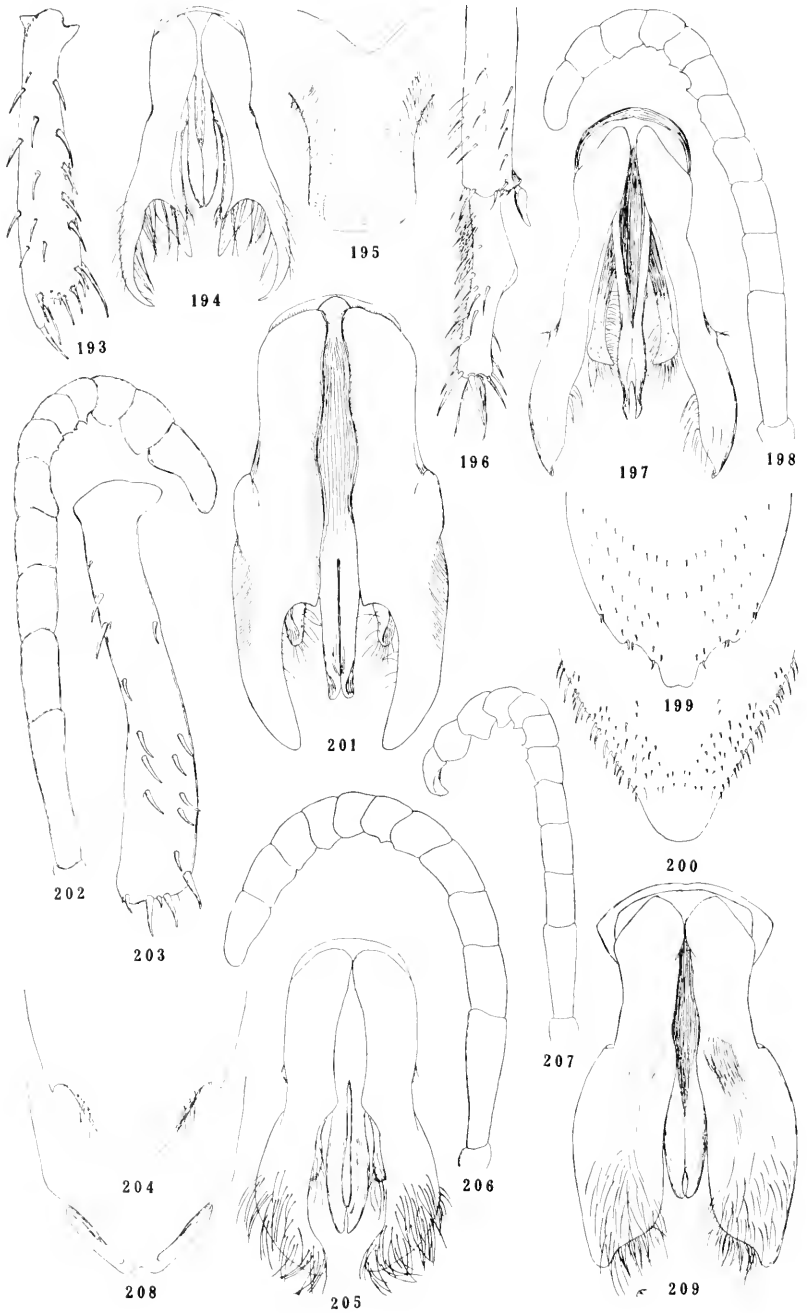
- FIG. 174. *Bembix regia* Parker. Middle tarsus, male.  
175. *Bembix regia* Parker. Genitalia, male.  
176. *Bembix regia* Parker. Middle femur, male.  
177. *Bembix regia* Parker. Anterior metatarsus, male.  
178. *Bembix regia* Parker. Spine of eighth sternite, lateral view, male.  
179. *Bembix regnata* Parker. Middle femur, male.  
180. *Bembix regnata* Parker. Middle tibia, male.  
181. *Bembix regnata* Parker. Flagellum, male.  
182. *Bembix regnata* Parker. Genitalia, male.  
183. *Bembix regnata* Parker. Seventh tergite, male.  
184. *Bembix residua* Parker. Flagellum, male.  
185. *Bembix residua* Parker. Genitalia, male.  
186. *Bembix residua* Parker. Seventh tergite, male.  
187. *Bembix rostrata* Linnaeus. Flagellum, male.  
188. *Bembix rostrata* Linnaeus. Genitalia, male.  
189. *Bembix rostrata* Linnaeus. Seventh tergite, male.  
190. *Bembix scutulata* Parker. Genitalia, male.  
191. *Bembix scutulata* Parker. Seventh tergite, male.  
192. *Bembix scutulata* Parker. Flagellum, male.





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FOSSORIAL WASPS OF STIZINI AND BEMBICINI

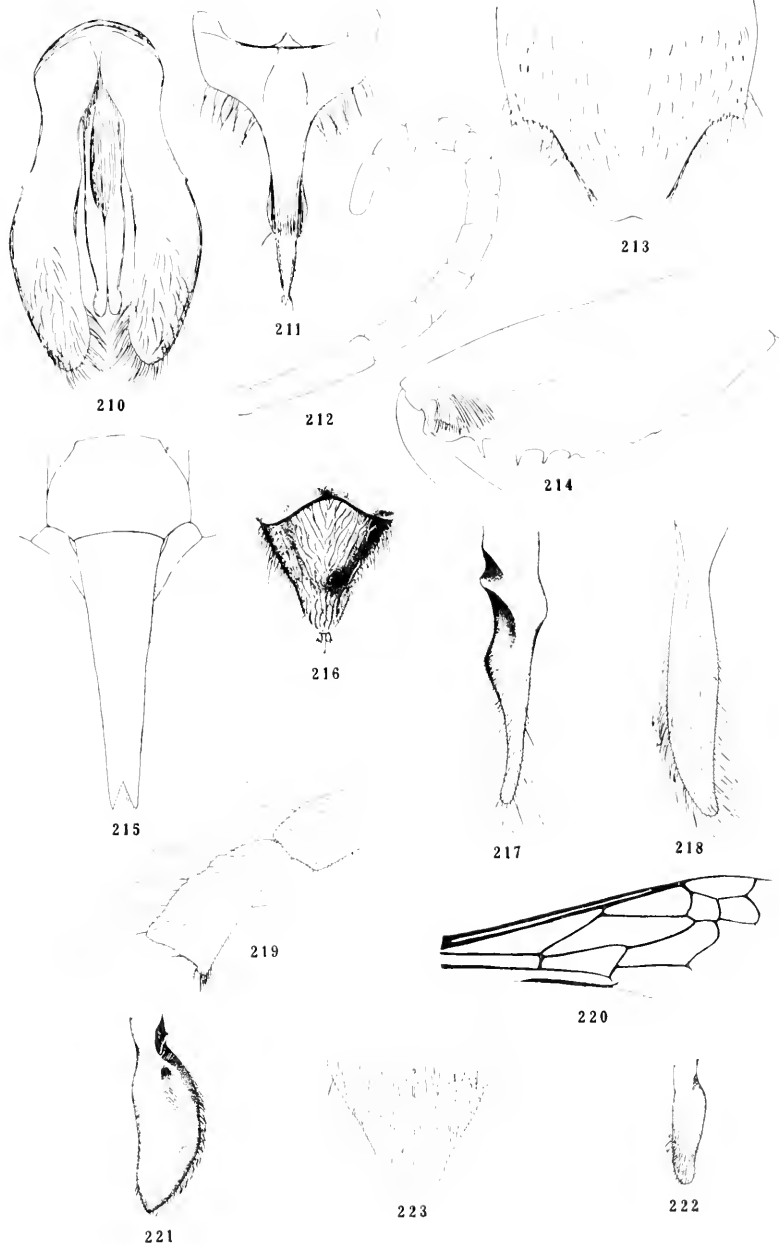
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- FIG. 193. *Bembix spatulata* Parker. Middle tibia, dorsal view, male.  
 194. *Bembix spatulata* Parker. Genitalia, male.  
 195. *Bembix spatulata* Parker. Seventh sternite, ventral view, male.  
 196. *Bembix stevensoni* Parker. Middle tibia and metatarsus, male.  
 197. *Bembix stevensoni* Parker. Genitalia, male.  
 198. *Bembix stevensoni* Parker. Flagellum, male.  
 199. *Bembix stevensoni* Parker. Seventh tergite, male.  
 200. *Bembix stevensoni* Parker. Sixth tergite, female.  
 201. *Bembix tenebrosa* Parker. Genitalia, male.  
 202. *Bembix tenebrosa* Parker. Flagellum, male.  
 203. *Bembix tenebrosa* Parker. Left middle tibia, dorsal view, male.  
 204. *Bembix tenuifasciata* Parker. Seventh tergite, male.  
 205. *Bembix tenuifasciata* Parker. Genitalia, male.  
 206. *Bembix tenuifasciata* Parker. Flagellum, male.  
 207. *Bembix trepanda* Dahlbom. Flagellum, male.  
 208. *Bembix trepanda* Dahlbom. Seventh tergite, male.  
 209. *Bembix trepanda* Dahlbom. Genitalia, male.

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- FIG. 210. *Bembix torosa* Parker. Genitalia, male.  
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212. *Bembix torosa* Parker. Flagellum, male.  
213. *Bembix torosa* Parker. Seventh tergite, male.  
214. *Bembix torosa* Parker. Middle femur, male.  
215. *Bembix rugosa* Parker. Labrum, female.  
216. *Bembix rugosa* Parker. Sixth tergite, female.  
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SOME NEW GENERA AND SPECIES OF NEMATODE  
WORMS, FILARIOIDEA, FROM ANIMALS DYING IN THE  
CALCUTTA ZOOLOGICAL GARDEN

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In the course of post-mortem examinations of animals which died in the Zoological Garden, Calcutta, India, a number of filarioid worms were collected. Some of these have already been described (Chandler, 1924). It is significant that every one of seven species studied has proved to be a new species, the worms belonging to at least five new genera.

Following the course adopted by most of the recent workers on this group, such as, Seurat, Skrjabin, Travassos, and Yorke and Maplestone, of splitting up the filariae into more numerous genera to conform with the accepted practice in other better known groups of parasitic nematodes, it appears advisable to erect a number of new genera for the species here described. Although a considerable number of the recently proposed genera of filariae contain only a single species, it is very probable that other species will be found in many of them, for the filariid parasites have been far less thoroughly collected and studied than some of the groups which are parasitic in the alimentary canal.

Among the forms here described is one, *Thylaconema sigmura*, new genus, new species, which seems to have closer affinities with the Thelaziidae than with any other family of the suborder Spirurata. The worm is, however, a parasite of the abdominal cavity and produces living embryos, which presumably escape from the body of the host in the orthodox manner of the filariae, that is, by being sucked up with the blood by blood-sucking arthropods. The other members of the Thelaziidae are parasitic in the orbital or nasal sacs of mammals or birds, in the air sacs of birds, or in the intestines of fishes; with the exception of some of the parasites of aquatic hosts, they produce living embryos which presumably are transmitted by blood-sucking arthropods. In this family there are, furthermore, no distinct

lips, although there is a small chitinized buccal cavity surrounded by two, four, or six poorly defined lobes. There are other genera, as *Breinlia*, *Litomosa*, and *Hamulofilaria*, the affinities of which with the Filarioidea seem not to have been questioned, which possess this characteristic. The type genus of the family, *Thelazia*, furthermore, has the vulva in the esophageal region and has a filarioid type of tail without the ornamentation or alae which are so characteristic of the majority of the spiruroids. This character is not shared by *Thylaconema*, providing the male found with the type female is actually the same species, but the habitat and probable life history of the worm is more characteristically filarioid than is the case with *Thelazia*. It seems to the writer that although the Thelaziidae are in many respects intermediate between the Filarioidea and the Spiruroidea, they can more conveniently be included with the former, as proposed by Travassos (1918), than with the latter.

The separation of a subfamily Aproctinae from the Filariinae, proposed by Yorke and Maplestone (1926) on the basis of the approximate equality or inequality of the spicules, does not seem to the writer to be acceptable, since there are no other differential characters to separate these groups.

#### PROTOFILARIA, new genus

*Generic diagnosis*.—Filariidae; Filariinae: Body slender and cylindrical, attenuated at the extremities. Head bluntly rounded, the mouth without either lips or evident papillae, the minute oral tube entering the esophagus a few micra from the anterior end. Cuticle smooth, without striations or ornamentations of any kind. Esophagus simple and cylindrical. Tail of female truncated, with a dorsoventral cleft dividing it into two short lobes, and with the anus in the cleft at the posterior extremity. Vulva near posterior end of esophagus. Opisthodelphic and viviparous. Males with posterior end curled, with short conical tail without either alae or papillae. Spicules dissimilar and unequal, one spoon shaped, the other bluntly pointed. Parasites of thoracic cavity of mammals.

*Type species*.—*Protofilaria furcata*, new species.

#### PROTOFILARIA FURCATA, new species

Figs. 1 and 2

*Specific diagnosis*.—Protofilaria: Moderately slender worm; cylindrical, tapering for the anterior 1.5 to 2 mm. at the head end and narrowing at the posterior end in a similar manner to a bluntly rounded and slightly indented end in the female and to a short conical tail in the male. Cuticle smooth, without striations or modifications of any kind. Head bluntly rounded, without lips or evident papillae



Mouth opening very minute, leading by a minute tube about  $10\mu$  in length to the esophagus. Esophagus simple, cylindrical, about  $800\mu$  to 1 mm. long. Nerve ring about  $240\mu$  to  $260\mu$  from anterior end.

*Male* about 13 to 15 mm. long with a maximum diameter of  $150\mu$  to  $175\mu$ . Head about  $73\mu$  to  $75\mu$  in diameter. Esophagus  $790\mu$  to  $850\mu$  long, the nerve ring  $240\mu$  to  $260\mu$  from its anterior end. Tail conical,  $85\mu$  to  $90\mu$  in length, about  $75\mu$  wide at the level of the cloaca and tapering to a rounded tip about  $10\mu$  wide. Spicules dissimilar and unequal in length, the short right one curved, troughlike, about  $70\mu$  long, ending in a blunt point somewhat resembling the point of a stub pen; left one trough shaped, with the sides rolled together proximally, but distally expanded into a curved, spoon-shaped structure; total length about  $115\mu$  with a width of about  $12\mu$  to  $13\mu$ . The body substance inside the cuticle at the posterior end of the tail ends in a number of inconspicuous digitations, but there are no papillae.

*Female* 29 to 30 mm. long with a maximum diameter of about  $325$  to  $330\mu$ . Head about  $95\mu$  in diameter. Esophagus about  $980\mu$  long, the nerve ring about  $260\mu$  from its anterior end. Posterior end of body tapers down in about the last 1.5 mm. of its length to a diameter at its posterior end of about  $145\mu$ . The tip of the body is abruptly truncated with a terminal indentation giving the appearance of a cleft chin, the cleft running around the end of the body from the dorsal to the ventral side. The anus is situated in the cleft at the posterior extremity of the body. The vulva is situated about 1.4 mm. from the anterior end. The uteri and ovaries extend posteriorly and terminate a few hundred micra from the posterior extremity. Uteri filled with hatched embryos.

*Host*.—Ruffed lemur (*Lemur ruber*).

*Location*.—Thoracic cavity.

*Locality*.—Calcutta Zoological Garden, Calcutta, India.

This lemur is an inhabitant of Madagascar, and presumably acquired the filariae in its native home.

*Type specimens*.—United States National Museum Helminthological Collections No. 8004; No. 8005.

#### APROCTOIDES, new genus

*Generic diagnosis*.—Filariidae; Filariinae: Body rather coarse, cylindrical, with rounded ends. Cuticle smooth, unstriated. Mouth provided with three very flat inconspicuous lips. Esophagus short, divided into a very short anterior portion and a longer posterior portion. Posterior end of male rolled in a close spiral, the tail short and rounded, without alae or papillae. Cloaca situated on a conspicuous prominence. Posterior part of intestine slender but not

atrophied. Spicules very small, similar in form but unequal in size, the left one more than twice as long as the right. Female unknown. Habitat, orbital cavity of birds.

*Type species.*—*Aproctooides lissum*, new species.

This genus is unquestionably closely related to *Aprocta* but differs from all the species included in that genus in two characteristics; first, in the division of the esophagus into two distinct portions and, second, in the very marked difference in the length of the spicules. The latter by itself does not appear to the writer to be a character of generic value, although Yorke and Maplestone separate the Aproctinae from the Filariinae on the basis of similarity and approximate equality of the spicules in the former group and dissimilarity and inequality in size in the latter. There would appear to be as much justification for splitting up the Filariinae of Yorke and Maplestone into a number of subfamilies, since they differ so greatly in the form of their spicules, as for separating off one group in which the spicules chance to be approximately equal and not widely different in structure, especially in view of the fact that these two characteristics tend to go together. The character of the esophagus, however, especially when accompanied by another minor difference, seems to the writer sufficient reason for the erection of a new genus. Furthermore, in the male at least, the posterior part of the intestine is not degenerate or atrophied, but according to Railliet and Henry (1910) and also Skrjabin (1917*a* and 1917*b*) the absence of an anus and the atrophy of the posterior part of the digestive tract appears not to be a characteristic of the genus *Aprocta* as was at first thought to be the case by von Linstow (1883). In some species at least the posterior end of the digestive tract is very much attenuated.

**APROCTOIDES LISSUM, new species**

Figs. 5 and 6

*Specific diagnosis.*—*Aproctooides*:

*Male* 12 mm. long with a maximum diameter of about 350 $\mu$ ; both ends bluntly rounded, the diameter at the posterior end of the esophagus being about 300 $\mu$ , and just anterior to the cloaca about 215 $\mu$ . Cuticle smooth, without either transverse or longitudinal striations. Mouth provided with three very inconspicuous flattened lips. Anterior portion of the esophagus about 155 $\mu$  long, with rather ill-defined and not quite cylindrical sides; posterior part about 575 $\mu$  long, cylindrical, with sharply defined walls, somewhat broader than the anterior part, with a uniform diameter of about 105 $\mu$ . Genital tube much folded and twisted, but not spirally wound around the intestine. Tail bluntly rounded, the cloaca situated on a conspicuous prominence about 145 $\mu$  from the posterior end. Spicules similar in form, much broader proximally than distally, and

with the sides rolled to form troughs; right spicule about  $130\mu$  long, the left one about  $300\mu$  long and curved more or less to follow the ventral contour of the body.

*Female*.—Unknown.

*Host*.—Dhyal bird or magpie robin (*Copsychus saulatus*).

*Location*.—Orbital cavity.

*Locality*.—Calcutta Zoological Garden, Calcutta, India.

*Type specimen*.—United States National Museum Helminthological Collection No. 8006.

**DIROFILARIA (?) DIGITATA, new species**

Figs. 3 and 4

*Specific diagnosis*.—?*Dirofilaria*:

*Male*.—Unknown.

*Female* a long slender worm, attenuated at each end to a very slender head and tail. Length 170 to 210 mm. with a maximum diameter of about  $380\mu$ . Cuticle smooth, unstriated, and without other ornamentation. Head very slender, with a diameter of about  $55\mu$  to  $60\mu$ . Mouth opening extremely minute, without lips or evident papillae, and no vestibule present. Esophagus very fine and slender, only about  $11\mu$  to  $12\mu$  in diameter, and not easily observable except where it is bent and runs at an angle to the long axis of the body. The junction with the intestine is not sharply demarcated, the intestine tapering conelike to the junction with the esophagus. The esophagus is about 1.1 to 1.3 mm. in length; nerve ring about  $160\mu$  from the anterior end. The anus is a very minute opening, situated about  $330\mu$  from the tip of the tail. The intestine in the last half millimeter of its length tapers down to a narrow tube of uneven diameter. The vulva is a longitudinal slitlike opening, bounded by slightly salient lips, situated just anterior to the junction of esophagus and intestine. The lumen of the anterior part of the vagina is narrow, and the wall is very thick and muscular (fig. 3), but a few hundred micra from the vulva the lumen widens and the wall narrows. The uterus bifurcates about 4 to 5 mm. from the anterior end of the body and the ovaries terminate a short distance anterior to the anus in the posterior part of the body. The tail of the female (fig. 4) is long, slender, and cylindrical,  $40\mu$  in diameter, and bluntly rounded at its termination, where it bears two pairs of digitiform papillae as shown in figure 4.

*Host*.—Hoolock ape (*Hylobates hoolock*).

*Location*.—Abdominal cavity.

*Locality*.—Calcutta Zoological Garden, Calcutta, India.

*Type specimens*.—United States National Museum Helminthological Collection No. 8007; paratypes No. 8008.

Three females of this worm were found. In the absence of any male specimens its generic affinities can not be determined with certainty, but so far as the female characters indicate, it appears to be closely related to *Dirioflaria*, in which genus it is provisionally placed. It differs from *D. corynodes* (Linstow, 1899), a species found in West African monkeys, in the much greater diameter relative to the length, in the presence of four instead of two digitiform processes at the end of the female tail, and in the position of the anus.

**HASTOSPICULUM SPINIGERUM, new species**

Figs. 7 to 11

*Specific diagnosis.*—*Hastospiculum*: A very long, stout, cylindrical worm, bluntly rounded at each end, but slightly greater in diameter near the anterior than near the posterior end. Cuticle in both sexes with moderately fine striations, becoming finer at the extreme anterior end. In the female certain of the striations become greatly thickened, forming prominent ridges which partially encircle the body. Each ridge is produced into one or more spinelike processes, which gives the cuticle a very rough texture. (Fig. 11.) In the male certain of the fine striations are also enlarged at intervals, but they are not produced into spines as in the females. The anterior end has a small craterlike depression, in the center of which is the mouth. On each side of the mouth is a small, truncated, pillarlike chitinous process, with three minute papillae at the base of each, not clearly visible except in end view. (Fig. 10.) The chitinous epaulettelike structures and circumoral papillae described for the other species of the genus are very rudimentary if present at all, and do not correspond either with the figures given by Skrjabin (1923) for *H. varani* or by Yorke and Maplestone (1926) for *H. gouldi*. The depression in the center of which the mouth is situated is about  $350\mu$  to  $400\mu$  in diameter in the female, bounded only by irregular and discontinuous chitinous folds or ridges. Immediately around the mouth is a more or less rectangular area of slightly thicker chitin, at either side of which is situated one of the chitinous pillars with three minute papillae at its base. Indications of another demarcated chitinized area widening the oral region dorsoventrally can also be seen. The esophagus consists of two parts as in other members of the genus, the anterior part being short and of moderate diameter, the posterior part long and very wide.

*Male.*—The single male specimen available lacks the head end. The portion available is about 75 mm. long, with a diameter of about  $560\mu$ . The posterior extremity tapers for about the last 4 or 5 mm. of its length and has a bluntly rounded end provided with a bursa-like structure formed by short caudal alae which meet posterior to

the end of the tail. (Fig. 8.) The bursalike structure (fig. 9) is about  $230\mu$  long and  $220\mu$  wide. The cloaca is situated slightly to the right of the posterior end of the body. The pedunculated preanal papillae are asymmetrical. On the right side there are three consecutively larger papillae situated near the junction of the right ala with the body; posterior to these there are two large papillae more ventrally situated, then a very short ventrally placed papilla, and finally, in the right ala just anterior to the cloaca, is another long papilla. At the posterior extremity, to the left of the cloaca, is a group of three sessile papillae, one larger than the other two. In the left ala only three papillae could be observed, two situated near the junction of the anterior end of the ala with the body, and one near the middle of the ala. The spicules are very unequal; the right one is about  $2.75$  mm. long with a nearly uniform diameter of about  $42\mu$ . Its tip is flattened and very slightly expanded, ending in a sharp, curved point. The small left spicule is curved, its sides rolled over to form a partially closed tube; it measures about  $420\mu$  in length with a diameter, before its slight expansion at the proximal end, about the same as that of the longer spicule.

*Female*.—The females are very large and measure 220 mm. or more in length, with a diameter of about 2 mm. The anterior part of the esophagus is about  $550\mu$  to  $570\mu$  in length with a diameter of about  $220\mu$ . The posterior part is about  $520\mu$  in diameter; its length could not be determined on account of the thickness of the worms. The vulva opens by a transverse slitlike aperture about  $850\mu$  from the anterior end. The tail is bluntly rounded, but slightly smaller in diameter than the head. The anus is at the posterior extremity. The eggs measure from  $50\mu$  to  $52\mu$  by  $33\mu$  to  $34\mu$ ; they have a thick shell, further thickened into a collar near each end, the ends being covered by thin opercula; they contain developed embryos while still in the uteri.

*Host*.—*Varanus flavescens*.

*Location*.—Under lining of peritoneum.

*Locality*.—Calcutta Zoological Garden, Calcutta, India.

*Type specimens*.—United States Natural Museum Helminthological Collection No. 8009; paratypes No. 8010.

This worm was found in three of six specimens of the above host. The worms were lying just under the serous membrane lining the peritoneal cavity, their bodies being thrown into rather regular waves. The method of escape of the eggs from the body was not determined, and nothing is known of the life cycle.

Although the complicated epaulettelike structures and oral papillae described by Skrjabin in his species, *H. varani*, which is the type species of the genus, are not developed in this species, there can be

no question of the close relationship of the two worms. *Hastospiculum gouldi* Yorke and Maplestone 1926, is a small worm with a number of oral papillae, small spicules, and a different arrangement of the caudal papillae of the male. *Filaria bipinnata* Linstow 1899 is also clearly a member of this genus, and should therefore be known as *Hastospiculum bipinnatum*; *H. gouldi* may possibly be identical with this species.

#### THYLACONEMA, new genus

*Generic diagnosis.*—Thelaziidae: Body comparatively coarse, tapering at each end. Cuticle coarsely annulated, the annulations provided with numerous backward projecting spines, most marked on the anterior half of the body. Mouth provided with a distinct and nearly square buccal cavity, the anterior borders of which close together slightly and have four very slightly salient lobes. Esophagus short and straight, not divided into two parts, and its demarcation from the intestine indistinct; the esophagus and intestine together form a straight narrow tube of uniform diameter for the whole length. Vulva in the esophageal region, the vagina an elongate saclike structure; opisthodelphic. Tail of female a short, narrow, fingerlike structure. Male uncertain; specimen found with type female lacks anterior end and can not be positively identified as the mate of the female worm. The generic characters of this specimen are as follows: Tail with broad and relatively short alae with a few large pedunculated preanal papillae and a few large and several small postanal ones. Spicules unequal, both long and slender; gubernaculum present. Parasites of the peritoneal cavity of birds.

*Type species.*—*Thylaconema sigmura*, new species.

#### THYLACONEMA SIGMURA, new species

Figs. 12 to 15

*Specific diagnosis.*—*Thylaconema*:

*Male* found associated with the type female lacks anterior end, and so can not be definitely diagnosed as the same species or even genus, although it probably is the same species. Maximum diameter  $270\mu$ ; tail (fig. 15) with broad and relatively short alae, forming a bursa-like structure  $400\mu$  long and about  $300\mu$  wide, marked with fine striations; two pairs of large pedunculated preanal papillae, one pair at the level of the anus, two pairs of postanal ones, and three or possibly four pairs of small ones near the tip of the tail. Anus  $175\mu$  from tip of tail. Spicules long and slender, the right one  $1.35$  mm. long, the left one  $590\mu$  long; gubernaculum present, consisting of two convergent chitinized bars connected by a delicate membrane.

*Female* about 15 mm. long with a maximum diameter of about  $400\mu$ . Diameter of head about  $65\mu$ , the diameter very gradually increasing posteriorly and more rapidly decreasing again near the

posterior end, terminating in a narrow fingerlike tail with bluntly rounded end. Cuticle with coarse annulations set about  $12\mu$  apart in the esophageal region and gradually becoming more widely spaced to intervals of  $25\mu$  to  $30\mu$  in the posterior part of the body; annulations provided with numerous small recurved spines. Mouth cavity (fig. 14) rectangular, about  $25\mu$  broad and  $15\mu$  deep with a further interval, with a narrow lumen, between the floor of the capsule and the anterior end of the esophagus. Anterior border of esophagus projecting slightly toward median line, giving the appearance of a pair of hawklike jaws in optical section. Head bounded by an inconspicuous ridge. Esophagus a straight narrow tube about  $875\mu$  long with a diameter of about  $55\mu$ ; nerve ring about  $450\mu$  from the anterior end. The intestine has the same diameter as the esophagus, the demarcation between the two being very indistinct; it continues back to the anus as a straight narrow tube; the anus is about  $155\mu$  from the posterior end. The posterior end of the body (fig. 13), gradually narrowing, curves S-like, ending in a ventrally curved, fingerlike tail with nearly parallel sides, about  $55\mu$  in diameter. At the anus it widens out to a diameter of about  $85\mu$ . Vulva  $390\mu$  from the anterior end, situated on a distinct prominence. Vagina an elongated saclike structure, about 1.4 mm. in length, gradually widening out to a diameter of about  $155\mu$  near its bluntly rounded end. The uteri open into the vagina by a narrow tube about  $35\mu$  in diameter; the two uteri split apart almost immediately and continue almost straight to the posterior part of the body where they abruptly narrow, ending in two slightly coiled ovaries.

*Host*.—Argus pheasant (*Argusianus argus*).

*Location*.—Peritoneal cavity.

*Locality*.—Calcutta Zoological Garden, Calcutta, India.

*Type specimens*.—United States National Museum Helminthological Collection No. 8011.

## EXPLANATION OF PLATES

### PLATE 1

- FIG. 1. *Protofilaria furcata*. Posterior end of male.  
 2. *Protofilaria furcata*. Posterior end of female, showing posterior extremities of ovaries. Anus in cleft at end, intestine not shown.  
 3. *Dirofilaria digitata*. Vulval region, showing vagina and union of esophagus and intestine.  
 4. *Dirofilaria digitata*. Tail of female, showing anus and posterior digitations.  
 5. *Aproctooides lissum*. Tail of male, showing spicules, intestine and sperm duct.  
 6. *Aproctooides lissum*. Head of male, showing esophagus and anterior end of testis.

## PLATE 2

*Hastospiculum spinigerum*

- FIG. 7. Anterior end of female, showing mouth, anterior end of esophagus, and vulva.
8. Posterior end of male, showing bursa-like structure and spicules.
9. Bursa-like structure, enlarged.
10. End view of mouth region, showing mouth opening, two pillar-like structures with three papillae at the base of each, and crater-like oral region.
- 10a. Egg.
11. Portion of cuticle on anterior part of body of female.

## PLATE 3

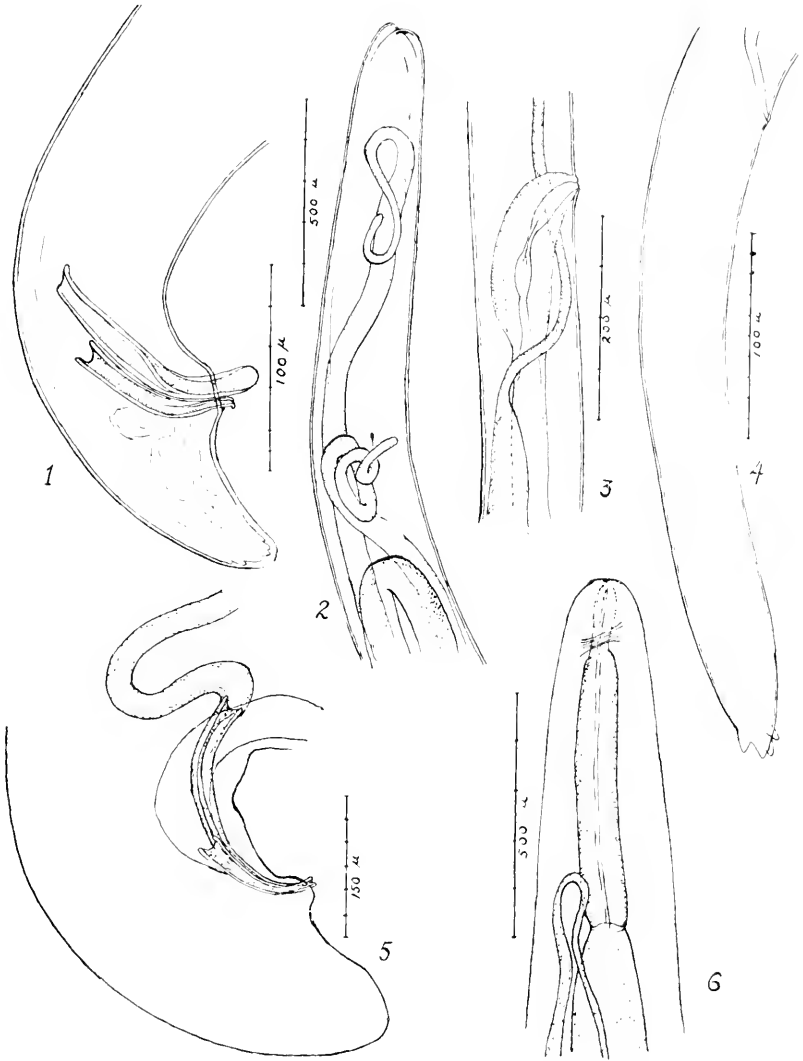
*Thylaconema sigmura*

- FIG. 12. Anterior end of female, showing head, esophagus, and vagina.
13. Posterior end of female, showing anus, tail and posterior loops of ovaries.
14. Head, much enlarged, showing buccal cavity and slender connection with esophagus.
15. Posterior end of male found with the type female, showing alae and spicules.

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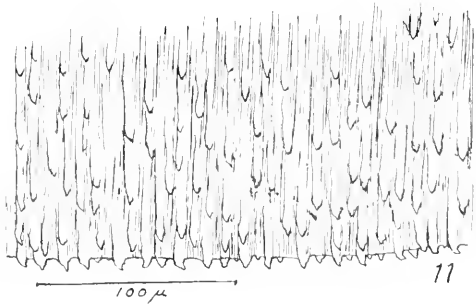
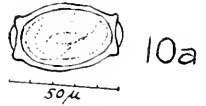
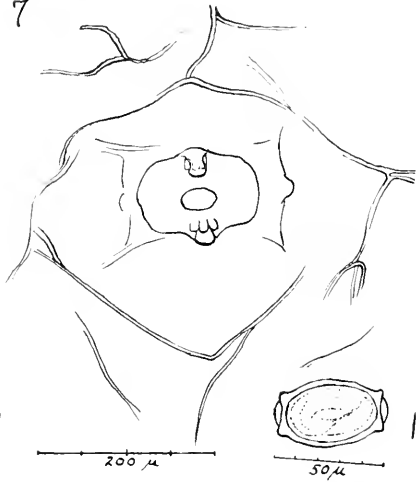
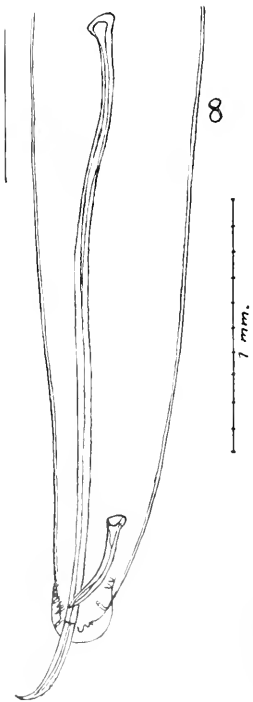
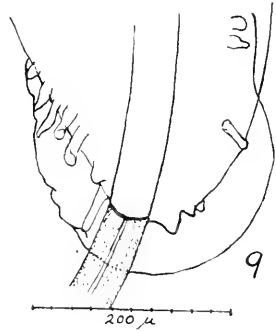
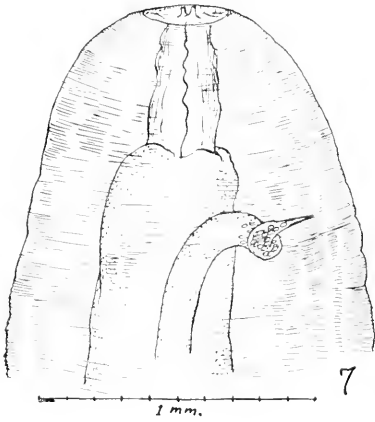
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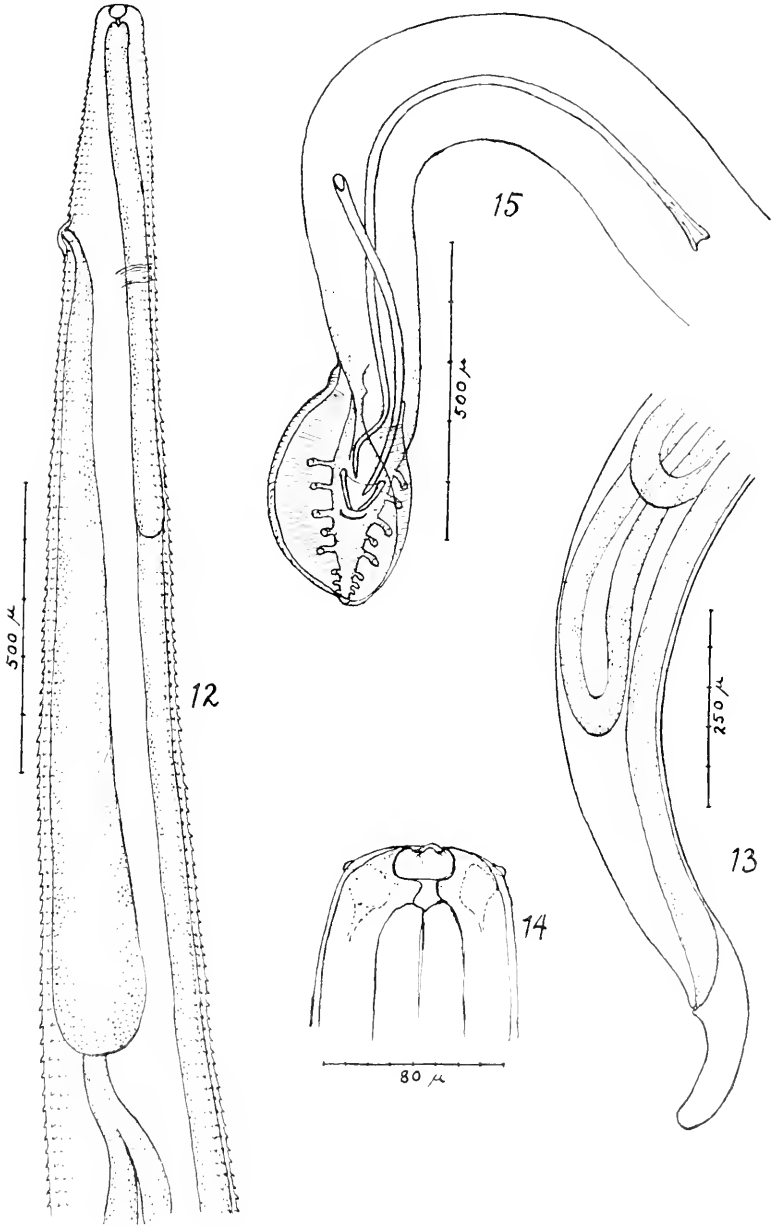
PROTOFILARIA FURCATA, DIROFILARIA DIGITATA AND APROCTOIDES LISSUM

FOR EXPLANATION OF PLATE SEE PAGE 9



HASTOSPICULUM SPINIGERUM

FOR EXPLANATION OF PLATE SEE PAGE 9



THYLAONEMA SIGMURA

FOR EXPLANATION OF PLATE SEE PAGE 11



# A REVISION OF THE AMERICAN TWO-WINGED FLIES OF THE PSYCHODID SUBFAMILY BRUCHOMYINAE

By CHARLES P. ALEXANDER

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The recent discovery of two undescribed species of the subfamily Bruchomyiinae, the most generalized of the four subfamilies of Psychodidae, makes it advisable to review our knowledge of this group of flies. Tillyard (1926), in writing of the genus *Nemopalpus*, one of the included genera, remarks as follows: "This genus, placed by some authors in Tanyderidae, unites that family with the Psychodidae, and is probably one of the oldest existing types of Diptera."

I wish to express my deepest thanks to the collector, Mr. Raymond C. Shannon, for the opportunity of studying and describing the two new Peruvian species of *Bruchomyia*.

## Subfamily BRUCHOMYINAE

1904. *Phlebotominae* EATON, Ent. Mo. Mag., ser. 2, vol. 15, p. 55 (part).  
1920. *Bruchomyiinae* ALEXANDER, Ann. Ent. Soc. America, vol. 13, p. 402.  
1921. *Nemopalpinae* EDWARDS, Ann. Mag. Nat. Hist., ser. 9, vol. 7, p. 439.  
1922. *Phlebotominae* TONNOIR, Ann. Soc. Ent. Belgique, vol. 62, p. 127 (part).  
1926. *Bruchomyiinae* CRAMPTON, Ent. News, vol. 37, pp. 33-39, 65-70.  
1927. *Bruchomyiinae* ALEXANDER, Genera Insectorum, fasc. 189, p. 3.  
1927. *Phlebotominae* SHANNON and DEL PONTE, Rev. Inst. Bact., Buenos Aires, vol. 4, p. 733 (part).  
1928. *Bruchomyiinae* EDWARDS, Journ. Fed. Malay St. Mus., vol. 14, p. 65.  
1928. *Bruchomyiinae* ALEXANDER, Proc. Linn. Soc. New South Wales, vol. 53, p. 292.

The use of the name Bruchomyiinae, based on the second proposed genus, *Bruchomyia*, in preference to *Nemopalpinae*, erected for the oldest genus, *Nemopalpus*, is on the principle of selection of the first proposed group of higher rank than the genus.

The Bruchomyiinae, including only the two genera *Nemopalpus* Macquart and *Bruchomyia* Alexander, appear to represent the most generalized of the recent Diptera. The subfamily is well differentiated from the Phlebotominae, with which it has sometimes been placed, by the retention of the primitive arrangement of the branches of *Rs*, this being dichotomously twice forked. In the Phlebotominae

the anterior branch of the posterior fork of  $R_s$ ,  $R_4$ , has been captured by the stem of the anterior fork,  $R_{2+3}$ , to form a short to longer fusion,  $R_{2+3+4}$ . Because the first branch of the sector,  $R_2$ , has not fused backward with  $R_1$ , the venation of the Phlebotominae appears pectinate.

The Bruchomyiinae may be separated from the remaining Psychodidae by the following key:

1. Radial sector,  $R_s$ , with four branches-----2.  
Radial sector,  $R_s$ , with three branches-----**TRICHOMYINAE.**
2. Distal section of vein  $Cu_1$  elongate, extending generally parallel to vein  $M_4$ , cell  $M_4$  at wing margin being approximately equal in width to cell  $M_3$ ; cell  $Cu$  sometimes very wide at margin, exceeding cell  $M_4$ ;  $Sc$  reduced,  $Sc_1$  and usually  $Sc_2$  atrophied-----**PSYCHODINAE.**  
Distal section of vein  $Cu_1$  short to very reduced, bent toward the axilla, longer and more nearly straight in *Bruchomyia*; cell  $M_4$  at wing margin as wide as or wider than cell  $Cu$ , usually very wide;  $Sc$  long,  $Sc_2$  and usually  $Sc_1$  preserved-----3.
3.  $R_s$  pectinately 4-branched,  $R_4$  being captured by the upper fork of the sector; mouth parts of female elongate, formed for blood sucking.  
**PHLEBOTOMINAE.**  
 $R_s$  dichotomously 4-branched,  $R_{2+3}$  and  $R_{4+5}$  being present; mouth parts normal, not formed for blood sucking-----**BRUCHOMYINAE.**

The Trichomyiinae (Tonnoir, 1922) will presumably include *Sycorax* Haliday. The validity of this group as a separate subfamily is confirmed by the recent discovery of the larva of *Sycorax*<sup>1</sup> erroneously considered by its discoverer as being a new genus of Dixidae. Edwards<sup>2</sup> has indicated the probability that *Sycorax* should represent a subfamily of Psychodidae.

The two genera of Bruchomyiinae may be separated as follows:

1. Antennae with 27-30 segments, including the reduced apical button; distal section of vein  $Cu_1$  long, approximately as long as the basal section.  
**Bruchomyia** Alexander.
- Antennae with 17 segments, including the reduced apical button; distal section of vein  $Cu_1$  short, curved strongly to the anal margin.  
**Nemopalpus** Macquart.

#### Genus BRUCHOMYIA Alexander

1920. *Bruchomyia* ALEXANDER, Ann. Ent. Soc. America, vol. 13, p. 403.

1927. *Bruchomyia* ALEXANDER, Genera Insectorum, fasc. 189, p. 4.

The genotype and hitherto only known species of *Bruchomyia* is *B. argentina* Alexander (1920), known only from various parts of Argentina. The species recently described as *Bruchomyia pallipes* Shannon and del Ponte (1927) is herewith transferred to the genus *Nemopalpus*. Two additional species of *Bruchomyia*, recently discovered in Peru by Raymond C. Shannon and kindly loaned to me for study, are described in the present report.

<sup>1</sup>G. W. Müller, Zettschr. Morph. Oekol. Tiere, vol. 7, pp. 535-542, 1927.

<sup>2</sup>Entomologist, vol. 61, pp. 207-208, 1928.

The generic definition of *Bruchomyia* must be slightly modified as a result of the discovery of these two novelties. The antennae in number of segments range from 27 to 30, the terminal segment being very small and buttonlike. Tonnoir (1922, p. 127, footnote) suggested that the increased number of flagellar segments in *Bruchomyia* might have been brought about by the bipartition of the 14-segmented flagellum in *Nemopalpus*. An examination of the three known species of *Bruchomyia* shows the impossibility of such an explanation, since the segments decrease gradually in size outwardly and there is no suggestion of a pairing of the segments, as would be the case if a primitive segment had been evenly subdivided. The chief venational peculiarity of *Bruchomyia* is the long sinuous distal section of  $Cu_1$ .

The only ecological notes available concerning this genus are those made by Doctor Bruch concerning the genotype, *argentina* (Alexander, 1927). "The flies always occur in damp places, being found on damp earth and in crevices of rocks. Pieces of wood, roots, moss, and other substances were examined critically, but the early stages could not be discovered. No plant mines were found and the larvae could not be located in the mud and wet earth along the margins of streams. In a position of rest, the adult flies sit rather high-legged, the wings held obliquely divergent. In copula, the male rests on the female, their bodies not being held in opposition. The flies are rather wary and take flight readily when disturbed. However, this flight is of brief duration and one can readily watch such a disturbed fly in flight and see it alight again."—*Bruch*.

KEY TO THE SPECIES OF BRUCHOMYIA ALEXANDER

1. General coloration of head and mesonotum dark gray; vestiture of head and thorax whitish; antennae (female) 29-segmented, the basal segment of flagellum subequal to the second. (Peru.)-----*peruviana*, new species.  
General coloration of head and mesonotum brown or yellowish, the vestiture pale brown to dark brown; antennae not 29-segmented, the first flagellar segment approximately one-half longer than the second.-----2.
2. General coloration pale yellow, the vestiture pale brown; antennae of male 28-segmented, of female 27-segmented, nearly as long as the body; no patch of dark setae on wing-disk at the bend of  $R_5$ , the latter not incrassated at this point. (Peru.)-----*shannoni*, new species.  
General coloration brown, with brown setae; antennae of male 30-segmented, shorter than the body; a patch of dark setae on wing-disk at the bend of  $R_5$ , the latter strongly incrassated at this point. (Argentina.)  
*argentina* Alexander.

BRUCHOMYIA ARGENTINA Alexander

1920. *Bruchomyia argentina* ALEXANDER, Ann. Ent. Soc. America, vol. 13, p. 405.

General appearance much like a *Molophilus*; antennae elongate, 30-segmented; a dark patch of setae at  $r-m$ .

The fly was described from La Granja, Alta Garcia, Province of Córdoba, Argentina, April 1-8, 1920 (Charles Bruch). More recently

(Shannon and del Ponte, 1927:733) the fly has been recorded from Tucumán, Salta, and Jujuy in Argentina.

*Paratype*.—Female, Cat. No. 41589, U.S.N.M.

**BRUCHOMYIA SHANNONI, new species**

General coloration pale yellow; antennae of male 28-segmented, of female 27-segmented, nearly as long as the body; wings uniformly pale, with pale brown macrotrichiae;  $M_1$  in alignment with  $M_{1+2}$ ,  $r-m$  at the fork of  $M_{1+2}$ .

*Male*.—Length, about 4.5 mm.; wing, 4.5–5 mm.; antenna about 4–5 mm.

*Female*.—Length, about 5 mm.; wing, 6 mm.

Rostrum yellow; palpi elongate, brownish yellow. Antennae of male unusually long for a member of this genus but varying in relative length in different specimens, 28-segmented, including the terminal button; first flagellar segment longest, more than one-half

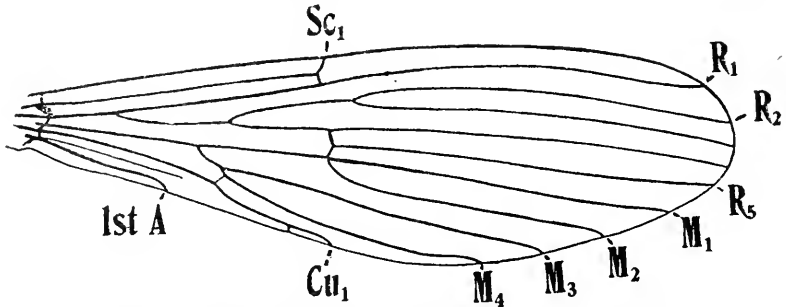


FIGURE 1.—WING-VENATION OF BRUCHOMYIA SHANNONI, NEW SPECIES:  
A=ANAL; CU=CUBITAL; M=MEDIAL; R=RADIAL; SC=SUBCOSTAL VEINS

longer than the second; succeeding flagellar segments gradually decreasing in length, the outermost oval, the terminal segment very reduced in size; flagellar segments clothed with long appressed to semiappressed setae; antennae pale, the setae brown. In the female antennae 27-segmented, the proportions of the segments about as in the male. Head yellowish testaceous, the center of the vertex somewhat darker.

Mesothorax entirely pale yellow to testaceous yellow, the notum somewhat darker, the conspicuous setae pale brown. Halteres pale, the knobs a little darker. Legs pale brown, clothed with chiefly pale appressed setae, with scattered smaller erect setae. Wings uniformly pale, with abundant pale brown macrotrichiae; costal fringe dense; no incrassation of  $R_5$  at bend or grouping of trichiae into a dark patch at this point as in *argentina*. Venation (fig. 1):  $Sc_2$  extending to about opposite three-fourths the length of  $R_{2+3}$ ,  $Sc_1$  subequal but pale and relatively indistinct;  $R_s$  gently angulated and broken at near midlength;  $R_{2+3}$  about one-third longer than  $R_{4+5}$ ; basal section



of  $R_3$  and  $r-m$  subequal and in transverse alignment; cell  $M_1$  sessile;  $m-cu$  very pale; distal section of  $Cu_1$  long, sinuous, in the specimen figured with a short branch before apex; cell  $M_4$  relatively narrow at margin, subequal to  $Cu$ ; vein  $1st A$  distinct, the cell a little wider on basal half. Most of the specimens lack the apical branch on the distal section of  $Cu_1$  and its occurrence must be held as adventitious.

Abdomen pale, densely clothed with long setae, very dense at end of organ, rendering it difficult to separate the two sexes. Male hypopygium (fig. 2) with the basistyle ( $b$ ) relatively stout, the outer face on basal two-thirds with numerous large setigerous punctures,

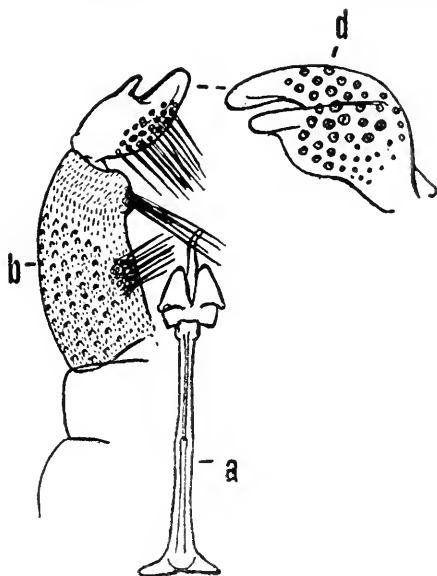


FIGURE 2.—MALE HYPOPYGIUM OF BRUCHOMYIA SHANNONI, NEW SPECIES:  
 $a$  = AEDEAGUS;  $b$  = BASISTYLE;  $d$  = DISTISTYLE

the apex of style with microscopic setulae only; mesal face of basistyle near apex with a small tuft of very long setae directed mesad and cephalad; ventral face of basistyle with a larger low tubercle bearing a dense brush of shorter setae. Dististyle ( $d$ ) small, the ventral outer face densely set with long erect setae, the dorsal face with a conspicuous lateral tooth or flange. Aedeagus ( $a$ ) appearing as a stout chitinized rod, extending cephalad into the seventh segment of the body.

*Locality*.—Peru.

*Holotype*.—Male, Verrugas Cañon, Department of Lima, April 7, 1928 (R. C. Shannon).

*Paratopotypes*.—Four males. *Allotopotype*.—Female.

*Type*.—Male, Cat. No. 41582, U.S.N.M.

This very distinct species of *Bruchomyia* is named in honor of the collector, my friend Raymond C. Shannon, to whom I am very

greatly indebted for the opportunity of studying not only the present material but other rich collections from many parts of the Americas.

**BRUCHOMYIA PERUVIANA, new species**

General coloration dark gray, the vestiture whitish; rostrum and palpi dark brown; antennae (female) 29-segmented, the basal 15 or 16 flagellar segments subequal in length; femora with appressed whitish setae.

*Female*.—Length, about 4.7 mm.; wing, 5 mm.

Rostrum and palpi dark brown. Antennae with the scapal segments pale yellow, the flagellum dark brown, 29-segmented, including the microscopic terminal button; first flagellar segment subequal in length to the second; proximal 15 or 16 flagellar segments nearly equal in length but becoming more slender, the ends a little constricted; succeeding segments gradually shortened, the outer segments more oval; terminal segment buttonlike; antennae much shorter than in the corresponding sex of *shannoni*. Head dark plumbeous gray.

Mesonotum dark gray, the lateral margins of the praescutum somewhat more brownish; setigerous punctures dark brown; vestiture of thorax whitish. Pleura dark brown. Halteres pale, the base of the stem whitish, the knobs infuscated. Legs with the coxae and trochanters infuscated; femora pale, with appressed whitish setae that are scarcely apparent against the background; tibiae and tarsi darker; segments of legs with sparse scattered erect setae. Wings yellowish subhyaline, the macrotrichiae brown; veins very pale brown. Costal fringe relatively short and inconspicuous. Venation as in *shannoni*, with the following modifications: *Rs* scarcely broken; proximal end of distal section of *R*<sub>5</sub> thickened, as in *argentina*, jutting as a weak spur into cell *R*; *r-m* on *M*<sub>1</sub> nearly its own length beyond the fork of *M*<sub>1+2</sub>; *M*<sub>3+4</sub> very short and arcuated; *m-cu* pale, without macrotrichiae; distal section of *Cu*<sub>1</sub> sinuous, longer than the basal section.

Abdomen dark brown, densely covered with white setae, the genital segments more yellowish.

*Locality*.—Peru.

*Holotype*.—Female, Colonia Pereké, Chanchomayo, altitude 3,000 feet (R. C. Shannon).

*Type*.—Female, Cat. No. 41581, U.S.N.M.

**Genus NEMOPALPUS Macquart**

1838. *Nemopalpus* MACQUART, Dipt. exot., vol. 1, pt. 1, p. 85.

1845. *Nygmatoles* LOEW, Dipterolog. Beiträge, vol. 1, p. 9.

1904. *Nemopalpus* EATON, Ent. Mo. Mag., ser. 2, vol. 15, p. 55.

1905. *Palaeosycorax* MEUNIER, Miscell. Ent., vol. 13, p. 50.

1922. *Nemopalpus* TONNOIR, Ann. Soc. Ent. Belgique, vol. 62, p. 125.

The genus *Nemopalpus* as now known is represented by six living and two additional fossil species. Of these, two closely allied forms occur in the New World and are discussed in the present report. The species are all very uncommon and their distribution as known is markedly discontinuous, indicating a palæogenic group of Diptera. The genotype, *flavus* Macquart (1838 a, 1838 b) was described from the Canary Islands. Since the original definition, a few additional specimens have been taken (Eaton, 1904; Becker, 1908), but the fly must be considered as being excessively rare. The New Zealand *N. zelandiae* Alexander (1921) and the Australian *N. australiensis* Alexander (1928) are the only known representatives in the Australasian Region. *N. orientalis* Edwards (1925) has recently been described from the Malay Peninsula and is the sole known representative of the subfamily in the Oriental Region. The two fossil forms, *N. tertiariae* (Meunier, 1905) and *N. molophilinus* Edwards (1921), are known only from Baltic Amber (Lower Oligocene).

In the New World the first described species was *N. pilipes* Tonnoir (1922), described from Paraguay, but now recorded from northeastern Argentina. The species recently described by Shannon and del Ponte as *Bruchomyia pallipes* proves to be more correctly referable to *Nemopalpus*. Although closely allied to *N. pilipes*, I believe the two species to be distinct.

The antennae of species of *Nemopalpus* have been described as being 16-segmented, but there is an additional tiny buttonlike segment at the end of the organ which is herein held to be 17-segmented. The chief point of difference in the venation from *Bruchomyia* is in the short distal section of  $Cu_1$ , which is scarcely one-half the basal section and rather conspicuously bent toward the anal angle. As a consequence, cell  $M_4$  at the margin is very wide.

Little is known concerning the ecology of any members of the genus. *Nemopalpus orientalis* Edwards was taken at Camerons Highlands, Gunong Berumban, Pahang, Federated Malay States, altitude 5,500 feet, March 14, 1924, by H. M. Pendlebury. Two specimens were observed, resting on damp moss on a tree trunk. These occurred in a type of rain-forest that was continually dampened by mist.

#### KEY TO THE NEOTROPICAL SPECIES OF NEMOPALPUS MACQUART

1. General coloration brown, the body and wings with abundant pale brown setae, the wings with additional patches of dark setae at fork of  $R_{2+3}$ ,  $r-m$ , base of  $M_3$ ,  $M_{3+4}$  and end of  $Cu_1$ , with paler and less distinct areas at ends of medial veins; legs pale brown, the tarsi paler. (Paraguay, Argentina.)

*pilipes* Tonnoir.

General coloration dark brown, the body and wings with almost black setae, the patches on the wings arranged as above but inconspicuous due to the dark color of the costal fringe; legs brownish black, the tarsi conspicuously pale. (Argentina)-----*pallipes* (Shannon and del Ponte).

Since the male sex of *pallipes* is still unknown, the above key is based only on the female sex. The male of *N. pilipes* is generally similar to the female in coloration but differs most remarkably in the extremely long dorsal fringes of setae on the tibiae and, less accentuated, on the basitarsi.

The South American species of *Nemopalpus* differ conspicuously from those of the old world in the venation,  $R_{2+3}$  being very elongate, exceeding three times  $R_2$  alone;  $r-m$  and the basal section of  $R_5$  lie far distad, being connected posteriorly with  $M_1$  far beyond the fork of  $M_{1+2}$ .

**NEMOPALPUS PILIPES** Tonnoir

1922. *Nemopalpus pilipes* TONNOIR, Ann. Soc. Ent. Belgique, vol. 62, pp. 130-134, 8 figs.

Tonnoir's description and figures are so complete that nothing further need be added. The species was described from material taken in Paraguay by Fiebrig. One additional male was taken at the Iguazu Falls, Argentina, October, 1927, by R. C. and Elnora Shannon, now preserved in the National Collection.

**NEMOPALPUS PALLIPES** (Shannon and del Ponte)

1927. *Bruchomyia pallipes* SHANNON and DEL PONTE, Rev. Inst. Bact., Buenos Aires, vol. 4, pp. 733-734.

The type of *pallipes*, a female, was taken at Iguazu Falls, Misiones, Argentina, June 21, 1927, by R. C. Shannon. The type was very kindly loaned to me for study by Mr. Shannon and Doctor Aldrich and a few supplementary notes are given.

*Female*.—Length about 4 mm.; wing 5 mm.

The species is undoubtedly closely allied to *N. pilipes*, but differs in the black coloration of the setae of the body and wings and the more conspicuously whitened tarsi.

Antennae pale, the setae black; 16-segmented, with an additional microscopic terminal button, as in the genus. Venation as in *pilipes*,  $Sc_1$  being distinctly preserved;  $R_{2+3}$  very elongate, the fork correspondingly shortened; basal section of  $R_5$  and  $r-m$  in transverse alignment, both far beyond the fork of  $M_{1+2}$ ; distal section of  $Cu_1$  very short. The long conspicuous crests of setae on head and thorax nearly black. Costal fringe very long and dense, brownish black, with paler hairs becoming more numerous on the distal half, the coloration of the fringe fully as dark as the hair patches on the disk, which are thus relatively inconspicuous. Legs with the vestiture appressed, with only scattered erect setae, dark-colored, those of the tarsi creamy, producing a pallid effect.

*Type*.—Female, Cat. No. 41580, U.S.N.M.

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# NOTES ON SOME NORTH AMERICAN MOTHS OF THE SUBFAMILY EUCOSMINAE

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Since the publication of my revision of the Eucosminae (U. S. Nat. Mus. Bull. 123, 1923) a large amount of additional material has been received, including the Fernald collection. These accretions have enabled me to make genitalic studies of types, cotypes, or other authentic specimens of species hitherto not available for dissection. They have also disclosed several new species for which names are required. The notes and descriptions in this paper are designed to make this new information available.

In the present paper 16 species and 3 varieties are described as new. The genitalia of 13 previously described species are figured for the first time, and notes are given on 9 other species.

I also take this opportunity to correct some errors in my previous papers dealing with this group, and to offer an amended key to the genus *Hystriophora*.

## THIODIA FORMOSANA SUBCANDIDA, new variety

Like *formosana*, except that hind wing of male is snow white toward base with a dark, smoky fuscous shading toward apex and along termen. This character holds through a long series from the type locality and seems to indicate a local race. In a large series of typical *formosana* before me the hind wings of both males and females are uniformly dark throughout. The genitalia of *subcandida* are also somewhat smaller than those of typical *formosana*, but of the same type.

*Alar expanse*.—17–21 mm.

*Type*.—Cat. No. 41198, U.S.N.M.

*Paratypes*.—In National collection, American Museum, Canadian National, Barnes and Bryant collections.

*Type locality*.—Bilby, Alberta, Canada.

*Food plant*.—Unknown.

Described from male type, 1 female and 20 male paratypes all from the type locality and bearing various June, 1924, dates (Owen Bryant, collector). In the female the hind wing is dark throughout as in typical *formosana*.

## THIODIA INSIGNATA Heinrich

## Figure 1

*Thiodia insignata* HEINRICH, Journ. Washington Acad. Sci., vol. 14, No. 16, 1924, p. 386.

Male genitalia figured from type.

## THIODIA LATENS, new species

## Figure 2

A pale, sordid grayish fuscous species hardly distinguishable from *delphinus* Heinrich except by genitalia.

Palpus, face, head, and thorax ashy grayish white. Fore wing ocherous white, dusted with fuscous, making the general color a pale, sordid fuscous; no distinct maculations except four pairs of white dashes on outer half of costa and an ocelloid patch consisting of a white spot containing one or two short black dashes or dots between two very obscure vertical pale bars, cilia fuscous, peppered with black and white (the scale ends white); termen slanting and slightly concave; veins 3, 4, and 5 approximate at termen. Hind wing concolorous with fore wing; cilia concolorous, with a slightly darker basal band; veins 3 and 4 united.

*Alar expanse*.—15 mm.

*Type*.—In collection Barnes.

*Paratypes*.—Cat. No. 41199, U.S.N.M., also in American Museum and collection Barnes.

*Type locality*.—Monachee Meadows, Tulare County, Calif. (8,000 feet).

*Food plant*.—Unknown.

Described from male type and seven male paratypes, all from the type locality ("July 8-14").

A distinct species easily distinguished by its genitalia, but in pattern and color very like *delphinus*. Specimens of the latter from its type locality have a paler ground color and a dark patch on base of fore wing which is lacking in *latens*. These characters, however, will not always serve, for in a series of *delphinus* before me (also from Monachee Meadows) the maculations are very obscure, the ground color darker, and the moths not to be distinguished from typical *latens* except by their genitalia (the genitalia and their tuftings making the end of the male abdomen considerably larger in *delphinus*).

## THIODIA LEPIDANA (Walsingham)

## Figure 7

Three specimens of this species collected by George V. Copley at Chilcotin, British Columbia ("15-IX-1925"), have been received from E. H. Blackmore. Two of these are now in his collection and one (a male) is in the United States National Museum. In both



pattern and genitalia *lepidana* resembles *kokana* Kearfott, which may be nothing but an eastern variety. The harpe of *lepidana* is somewhat smaller, however, and the cucullus more pointed at (costal) apex.

Male genitalia figured from specimen in the National collection.

THIODIA PARVANA (Walsingham)

Figure 6

The National collection has received from Dr. Annette Braun a male which, except for locality, answers in detail to Walsingham's description. In external characters it is similar to *fertoriana* Heinrich, but in genitalia quite distinct. It was collected at Yellowstone National Park Lake, Wyo. ("VII-5-24").

Male genitalia figured.

THIODIA PASTIGIATA, new species

Figure 3

A grayish white species with faint maculations and a fine black subterminal line in cilia of fore wing; similar to *griseocapitana* but lacking any trace of ochreous shading, with different marking of the cilia and different genitalia.

Palpus, face, head, and thorax white with a few black-brown spots on outer side of palpus, on sides of face near eyes, and on side of head just over base of antenna, and with a faint dusting of similarly colored scales on anterior margin of thorax; palpus scarcely extending the length of the head beyond it. Fore wing finely clouded and scatteringly lined with blackish brown scales giving it, to the naked eye, a rather sordid grayish white color; under magnification the dark markings show as a series of fine well-spaced lines on costa, a somewhat heavier series of crosslines on dorsum toward base indicating faintly a half basal patch, a slight clouding on dorsum near tornus, a similar clouding at apex of cell and toward termen, and two vertical dark lines (well separated) in ocelloid area; white ground color most appreciable on outer half of costa and as a white subapical costa spot; cilia white, with blackish brown basal dustings and a similarly colored subterminal line; veins 3, 4, and 5 not approximate at termen; termen slanting and straight. Hind wing smoky white; cilia white with a faintly darker basal band and (toward apex) a similar subterminal band; veins 3 and 4 stalked.

Male genitalia of type figured.

*Alar expanse*.—16-20 mm.

*Type*.—In collection Barnes.

*Paratypes*.—Cat. No. 41200, U.S.N.M., also in American Museum and collection Barnes.

*Type locality*.—Monachee Meadows, Tulare County, Calif.

*Food plant*.—Unknown.

Described from male type, eight male and four female paratypes, all from the type locality (8,000 feet, "July 8-14"). Nearest to *griseocapitana* Walsingham, which it precedes in my arrangement.

**THODIA BUCEPHALOIDES** (Walsingham)

Figure 4

A series of moths reared ("VIII-14-1925" and "IX-9-1925") from larvae boring in the roots of *Chrysothamnus linifolius* Greene and collected at Grand Junction, Colo., by George Englehardt, of the Brooklyn Museum, are now in the National collection. A specimen has also been deposited in the Barnes collection. These correspond to the female in the American Museum, mentioned in my revision of the Eucosminae, and are undoubtedly Walsingham's species or a Colorado variety thereof. The genitalia show them to be specifically distinct from *offectalis* Hust.

Male genitalia figured from specimen in the National collection.

**EUCOSMA FANDANA** Kearfott

Figure 12

A male of this species from the Fernald collection (Colorado, Oslar, "157") is now in the National collection.

Male genitalia figured.

**EUCOSMA LATICURVA**, new species

A tawny yellow species with two broad, irregular, longitudinal, silver markings on fore wing.

Palpus white; second joint shaded on outer side with tawny yellow and fuscous. Head white. Thorax tawny yellow with some white scaling on posterior margin and with posterior two-thirds of tegula white. Fore wing tawny yellow with a broad silver white band starting from base of dorsum (where it occupies all of extreme base except a narrow margin of costa), curving up to vein 12, thence down to mid dorsum, broadening somewhat and then connecting by a narrow spur with a square white patch at tornus, the whole forming a broad serpentine band extending from base to tornus; a broad crescentiform spot occupying outer third of costa and inclosing on costa a small patch of the ground color; an obscure narrow white patch on termen extending from just below apex to vein 5; a sparse dusting of blackish scales scattered along the margins of the white markings and along base of cilia; cilia pale ochreous.

Hind wing pale smoky fuscous; cilia paler with a dark basal band.

Male genitalia similar to those of *agasizzii* except somewhat smaller; in size between those of *agasizzii* and *bolanderana*.

*Alar expanse*.—22 mm.

*Type*.—Cat. No. 41201, U.S.N.M.

*Paratype*.—In collection Barnes.

*Type locality*.—"Sierra Nevada," Calif.

*Food plant*.—Unknown.

Described from male type from the Fernald collection ("No. 3029") and one male paratype from the Barnes collection ("Mount Shasta District," California).

Close to *agasizii* Robinson, from which it chiefly differs in the broader and more strongly curved median serpentine band.

EUCOSMA VAPSILIS, new species

Figure 9

A brown species with irregular, moderately broad, silver-white markings on fore wing.

Palpus fuscous, white scaled beneath toward base and with second joint white on inner side toward apex. Head and thorax ashy fuscous (the scales brown with white tips) with posterior extremity of thorax whitish. Fore wing ground color light brown; a small white spot on extreme base at middle; from dorsum close to base an irregular white bar extending upward to top of cell at one-fourth; beyond this an  $\infty$  shaped, moderately broad white band extending from basal third of dorsum almost to tornus; from top of this a white spur extends backward and upward to top of cell, sometimes fusing with the first white bar; at outer extremity of the  $\infty$  band two parallel white streaks to tornus, extending into the cilia; on mid dorsum a narrow white spot which sometimes extends backward and fuses with the beginning of the  $\infty$  band; on costa just beyond middle a crescentiform white band with an included small white costal spot; a larger white costal spot on costa near apex; two strong white costal dashes on termen below apex, fusing at their bases and extending into the cilia; cilia slightly paler than the ground color of wing; underside of wing fuscous with the white markings strongly indicated on outer half of costa and on termen and on cilia below apex and at termen, other white markings faintly indicated; veins 3, 4, and 5 well separated at termen. Hind wing fuscous, nearly concolorous with fore wing; underside shaded with whitish; the white forming a rather conspicuous spot on costa near apex; cilia paler with a dark basal band.

Male genitalia figured from type.

*Alar expanse*.—27-28 mm.

*Type*.—Cat. No. 41202, U.S.N.M.

*Paratypes*.—In collection Barnes, American Museum, and Canadian National collection.

*Type locality*.—Yellowstone National Park, Wyo.

*Food plant.*—Unknown.

Described from male type and four male paratypes from the type locality.

A striking and distinct species falling between *laticurva* and *bolanderana* in our arrangement; but different from both in ground color, pattern, and genitalia.

**EUCOSMA RUSSEOLA, new species**

Figure 20

An unmarked reddish ochereous species with pale hind wings.

Palpus whitish ochereous on inner side; reddish ochereous on outer side, darkest toward apex. Face and head whitish ochereous; head tufts shading into reddish ochereous. Thorax and fore wing a unicolorous reddish ochereous, in dark specimens almost rust color; no ocelloid patch; in one specimen a few scattered very minute black scales toward termen; cilia concolorous with wing and with a dark (brownish) basal band; veins 3, 4, and 5 not approximate at termen; termen decidedly slanting and very slightly concave. Hind wing pale whitish ochereous, more white toward base and more yellowish toward apex and termen; cilia sordid whitish with a slightly darker basal band; veins 3 and 4 very long stalked.

Male genitalia of the *morrisoni-agricolana-pergandiana* type; figured from type.

*Alar expanse.*—20 mm.

*Type.*—Cat. No. 41203, U.S.N.M.

*Paratypes.*—In National collection, American Museum, and collection Barnes.

*Type locality.*—Los Angeles, Calif.

*Food plant.*—Unknown.

Described from male type ("June 11 '21—No. 127M," Karl R. Coolidge, collector) from the type locality and two males and one female from Loma Linda, Calif.

An easily recognized species resembling in color Kearfott's *immaculana*, but with narrower fore wing, paler hind wing, and quite different genitalia. In our arrangement would precede *luridana* Walsingham.

**EUCOSMA EBURATA, new species**

Figure 11

An ivory-colored species close and similar to *invicta* Walsingham, but with basal patch and outer fascia on fore wing much fainter (almost obsolete) and with no clear white unmarked area on mid dorsum.

Palpus sordid white, shaded with ferruginous-ochereous, especially on under side and toward apex; third joint entirely hidden under scaling of second. Face and head ferruginous-ochereous. Thorax

white, somewhat dusted with pale brown on anterior margin. Fore wing white, finely cross-lined with pale leaden gray and ocherous, giving the wing a grayish white color; an angulate dark basal patch very faintly indicated; a similar obscure patch on dorsum before tornus connecting with an even fainter marking from just beyond middle of costa and with it forming an almost obsolete angulate fascia; ocelloid patch an obscure white patch inwardly margined by a few black scales; above ocelloid patch a scattering of black scales; occasionally a few black scales on middle of cell at base and at outer angle of the basal patch; costal striations narrow, faint, continuous from base to apex; cilia white, with a broad basal peppering of black scales and a fuscous and black shading at apex; veins 3, 4, and 5 not approximate at termen; termen concave. Hind wing smoky fuscous; cilia white with a dark basal band.

Male genitalia figured from type.

*Alar expanse*.—22–25 mm.

*Type*.—In collection Barnes.

*Paratype*.—Cat. No. 41204, U.S.N.M., also in American Museum and collection Barnes.

*Type locality*.—Mohave County, Ariz.

*Food plant*.—Unknown.

Described from male type and three female paratypes, all from the type locality ("Aug. 24–31"). I have also before me a female from San Diego, Calif., and a somewhat smaller male from Paradise, Cochise County, Ariz., which are presumably the same or varieties of the same species.

EUCOSMA PERSOLITA, new species

Figure 14

An ashy white species with an oblique dark dash above dorsum beyond base and a dark triangular patch on dorsum near tornus.

Palpus, face, head, and thorax ashy white (the scales pale fuscous tipped with white), somewhat darker on outer side of palpus. Fore wing white, somewhat dusted with pale fuscous, making the ground color an ashy white, and with blackish fuscous maculations; beyond base above dorsum an oblique dark dash; on dorsum before tornus a prominent triangular dark patch; on costa beyond area of fold several narrow dark dashes interspaced with white lines; a conspicuous dark spot at apex, and bordering outer margin of ocelloid patch and curving above it a thin dark line; the costal maculations and apical spot faintly repeated on undersurface; ocelloid patch consisting of two broad, obscure, sordid white bars inclosing a black dot near their upper margins; cilia white dusted with blackish fuscous and with a dark basal line; veins 3, 4, and 5 somewhat approximate at termen; termen slightly concave. Hind wing pale ocherous fuscous; cilia white with a broad dark basal band and a dark outer shading.

Male genitalia similar to those of *matutina* Grote, but larger; figured from paratype in National collection.

*Alar expanse*.—14–21 mm.

*Type*.—In collection Barnes.

*Paratypes*.—Cat. No. 41205, U.S.N.M., also in American Museum, Canadian National, and Barnes collections.

*Type locality*.—San Benito, Tex.

*Food plant*.—Unknown.

Described from male type, 15 male and 3 female paratypes from the type locality ("Mch. 16–23," "Apr. 1–7"), and 12 male and 1 female paratypes from Brownsville, Tex. (various February and March dates).

Closest to *totana* Kearfott, which it resembles also somewhat in genitalia and from which it differs chiefly in the paler ground color and darker (more blackish) maculations of its fore wing. Follows *totana* in my arrangement.

**EUCOSMA PERPROPINQUA, new species**

Figure 13

A pale ocherous or whitish ocherous species of the *occipitana-reversana-daemonicana* group with an obscure dark patch in cell of fore wing near base and another on dorsum near tornus (these dark markings almost disappearing in some specimens), three or four rather conspicuous pure white spots on outer half of costa (in females), and veins 3 and 4 of hind wing united.

Palpus white dusted with ocherous fuscous on outer side. Face and head white. Thorax whitish ocherous. Fore wing white, dusted with pale ocherous fuscous, making the ground color a pale ocherous (in the male type much lighter, almost white); a slight dusting of darker (fuscous) scales on cell near base; on dorsum (or just above dorsal margin) before tornus a faint indication of a similar dark patch; costa of the ground color, weakly striated toward base and, on outer half, with three or four rather broad white spots with some fuscous dusting on the interspaces between (not distinguishable in the male type where the costal markings are obscured by diffusion of the whitish ground color); extreme apex dark; terminal margin below apex white; ocellus obsolete, represented by a couple of obscure brown dots or dashes; cilia rather strongly dusted with fuscous and with a distinct white dash just below apex; veins 3, 4, and 5 not approximate at termen; termen straight and slanting. Hind wing nearly concolorous with fore wing; cilia sordid white with a slightly darker basal band and (in dark specimens) a faint indication of a median band; veins 3 and 4 united.

Male genitalia similar to those of *occipitana*, but with cucullus perceptibly broader in proportion to rest of harpe. Figured from type.

*Alar expanse*.—20–26 mm.

*Type*.—In collection Barnes.

*Paratypes*.—Cat. No. 41206, U.S.N.M., also in American Museum, Canadian National, and Barnes collection.

*Type locality*.—Selis Post Office, Indian Oasis, Pima County, Ariz.

*Food plant*.—Unknown.

Described from male type and six female paratypes all from the type locality ("1–15 April" and "15–30 April," 1923, O. C. Poling, collector). I have also before me three females that I take to be the same species from Loma Linda, Calif.

In both pattern and genitalia this species is close to *occipitana* Zeller, *daemonicana* Heinrich and *reversana* Kearfott. From the first it differs in its paler ground color and generally larger size; from the two latter in the absence of a dark patch in outer area of cell and in its obscure dark markings generally. From all three it differs in details of genitalia.

#### EUCOSMA SHASTANA (Walsingham)

##### Figure 10

The National collection now has an authentic specimen (male) of this species (a Walsingham "type" from the Fernald collection). The genitalia show this to be quite distinct from what I identified as *shastana* and figured in my revision of the Eucosminae. In pattern the two forms are similar except that the outer dorsal patch on fore wing of the true *shastana* is decidedly excavate above and much broader than the outer dorsal patch of my supposed *shastana*. The latter, I am now convinced, is only a large variety of *tahoensis* Heinrich. I am describing it below under the varietal name *subditiva*.

Male genitalia of the Walsingham "type" figured.

#### EUCOSMA TAHOENSIS SUBDITIVA, new variety

*Eucosma shastana* HEINRICH (not Walsingham), U. S. Nat. Mus. Bull. 123, 1923, pp. 79, 113, fig. 221.

Palpus, face, head, and thorax ochereous fuscous; thorax with some slight dusting of fuscous, and with scale tips of tegulae white. Fore wing sordid whitish ochereous marked with fuscous; an outwardly slanting fuscous bar from dorsum near base to top of cell, constituting with a slight fuscous shading at extreme base the remains of a dark basal patch; on dorsum before tornus a large, irregularly triangular fuscous patch; above and behind it in cell near its apex a slight clouding of fuscous; below apex a conspicuous blotch of fuscous shading; costa faintly clouded with fuscous and with several fine darker fuscous striations to middle, beyond middle with four conspicuous fuscous dashes, interspaced with white and increasing in size

toward apex; all the larger fuscous markings more or less margined by black scales; ocelloid patch obscure, whitish ochereous; cilia ashy fuscous with two or three obscure white dashes below apex; veins 3, 4, and 5 not approximate at termen; termen slanting and very slightly concave. Hind wing smoky fuscous; cilia concolorous, with a dark basal band and the tips of the scales white.

*Alar expanse*.—27 mm.

*Type*.—In collection Barnes.

*Paratype*.—Cat. No. 41207, U.S.N.M., also in American Museum.

*Type locality*.—Deer Park Springs, Lake Tahoe, Calif.

*Food plant*.—Unknown.

Described from male type and two male paratypes from the type locality ("June 24-30"). These specimens I had previously determined as *shastana* Walsingham (see above) and the genitalia of the type I had figured under that name in my revision of the Eucosminae (fig. 221). I have also before me three males from Warner Mountains, "three miles east of Davis Creek," Modoc County, Calif. ("24-31 July 1922, 5,500 feet, A. W. Lindsey, collector"), which I take to be merely a color variety. They have similar genitalia and pattern but are considerably paler, the ground color being distinctly white. I should not name this variety at all were it not for the fact that its genitalia are about twice the size of those of typical *tahoensis*. If the species is a stem borer this may not be significant; but in the absence of intergrades and any information on larvae or life history it seems advisable to keep the two forms separate.

EUCOSMA NUNTIA, new species

Figure 15

A pale whitish gray species with a faint white transverse line from tornus to costa just beyond middle.

Palpus white, faintly dusted on outer side with fuscous. Antenna white, annulated with light brown. Face and head white. Thorax and fore wing white, finely dusted with ochereous fuscous, giving them a whitish (or cream) gray color; costa of fore wing faintly striated with white from base to apex; ocelloid patch obscure, consisting of three short black dashes or dots on a whitish field; from the latter a thin straight white line to the white strigulae of mid costa; cilia pale ochereous fuscous and white, finely dusted with black; underside of wing somewhat darker, finely and evenly dusted with fuscous. Hind wing but slightly darker than fore wing, pale fuscous; cilia white with a dark basal band.

Male genitalia of type figured.

*Alar expanse*.—19-23 mm.

*Type*.—In collection Barnes.

*Paratype*.—Cat. No. 41208, U.S.N.M., also in collection Barnes.



*Type locality*.—Callao, Juab County, Utah.

*Food plant*.—Unknown.

Described from male type, one male and one female paratype, all from the type locality and dated "17-IV-22" (males) and "23-VI-22" (female).

Similar in pattern to *corosana* Walsingham, but paler and lacking all traces of a dark basal patch in fore wing, also quite different in genitalia. Follows that species in our arrangement.

EUCOSMA INQUADRANA (Walsingham)

Figure 17

*Aphelia ? inquadrana* WALSINGHAM, Trans. Ent. Soc. London, 1884, p. 134.

*Bactra inquadrana* (Walsingham) FERNALD, In Dyar List N. Amer. Lepid., No. 5008, 1902.—BARNES and McDONNOUGH, Check List Lepid. Bor. Amer., No. 6791, 1917.

*Eucosma inquadrana* (Walsingham) HEINRICH, U. S. Nat. Mus. Bull. 132, 1926, p. 191.

Male genitalia figured from specimen in National collection from Sells Post Office, Pima County, Ariz. ("April-May, 1923").

*Alar expanse*.—14-18 mm.

*Type*.—In British Museum.

*Type locality*.—Arizona.

*Food plant*.—Unknown.

EUCOSMA NIROSIGNATA, new species

Figure 19

A whitish species of the *pulveratana* group with two prominent dark brown markings on dorsum of fore wing.

Palpus white, the scales on outer side spotted with ochereous fuscous and pure white at the tips, giving them a somewhat ashy hue. Head and thorax ashy white, scales colored as on the palpus. Fore wing white, dusted and lined with pale brown and ochereous fuscous; the costal striations pale brown, most distinct on outer half; at apex a rather conspicuous spot of the same color and below it a similarly colored subapical bar extending from middle of termen to outer fourth of costa; below this and just above ocellus an obscure clouding of dark (fuscous ochereous) scaling; on dorsum two very conspicuous, sharply contrasted, dark brown markings, a rather broad outwardly curved bar near basal third and extending up nearly to top of cell and a shorter triangular patch just before tornus, both these brown markings sharply defined and edged with white; ocelloid patch obscure, consisting of two silvery white vertical bars inclosing a dark shaded patch of the ground color; cilia white, heavily peppered with blackish and pale brown; veins 3, 4, and 5 approximate at termen; termen convex. Hind wing pale smoky fuscous; cilia slightly paler, with an obscure, somewhat darker basal band.

Male genitalia similar to those of *pulvertana* Walsingham, but with stronger, more numerous (6) marginal spines at apex of cucullus and with sacculus more bluntly rounded at incurvation of neck of harpe. Figured from type.

*Alar expanse*.—13–22 mm.

*Type*.—In collection Barnes.

*Paratype*.—Cat. No. 41209, U.S.N.M., also in American Museum, Canadian National, and Barnes collections.

*Type locality*.—Baboquivari Mountains, Pima County, Ariz.

*Food plant*.—Unknown.

Described from male type ("15–30 Oct., 1924," O. C. Poling, collector), 15 female paratypes from the type locality (dated "15–30 April," "1–15 May," "15–30 May," "27–31 July," "1–15 Sept.," and "15–30 Nov.," all O. C. Poling's 1924 collecting), 2 female paratypes from Loma Linda, Calif. (dated "Aug. 24–31" and "Oct. 16–23"), 1 female paratype from Claremont, Calif., 1 female paratype from San Diego, Calif. ("Aug. 14, 1920," Karl R. Coolidge), and 1 female paratype labeled "California." A few of these females have been in our collection for some time, either unplaced or under erroneous names, confused with *Eucosma pulveratana*, *Suleima helianthana*, or *S. lago-pana*. The species is very close to *pulveratana* and *sudana*. From the former it differs chiefly in the paler (more whitish) ground color of the fore wing and from the latter in the absence of any pronounced median costal spot and the less dilated subapical bar of fore wing. From both it differs in slight details of the genitalia.

EUCOSMA JUNCTICILIANA (Walsingham)

Figures 18, 32.

In Bulletin 123, United States National Museum (p. 123), I expressed some doubt that what Fernald and others had determined as *juncticiliana* and what had been going under that name in our collections was really Walsingham's species. The acquisition by the United States National Museum of the Fernald collection has enabled me to make genitalia slides of specimens from the type locality and actually determined by Walsingham. Two of these are labeled "type" and are very likely cotypes from the original Walsingham series, one is labeled "*Rhyacionia juncticiliana* Walsingham, Cal.," and the other has simply a name label without locality or other data. The four are all males and in genitalia agree with the Walsingham specimen in the American Museum (mentioned in my revision), and differ appreciably from what we have been commonly calling *juncticiliana*, too much so, I now believe, to permit us to consider the two forms as anything but separate species. The *juncticiliana* of authors being therefore without a name, I am describing it below as a new species.

Male genitalia of *juncticiliana* figured from cotype in National collection.

*Food plant*.—Unknown.

**EUCOSMA DERELICTA, new species**

Figure 30

*Eucosma juncticiliana* (authors, not Walsingham) FERNALD, in Dyar List N. Amer. Lepid., No. 5121, 1902 (part).—KEARFOTT, Proc. U. S. Nat. Mus., vol. 28, 1905, p. 354; Can. Ent., vol. 37, 1905, p. 209.—HEINRICH, U. S. Nat. Mus. Bull. No. 123, 1923, p. 122, fig. 155.

In color and markings similar to *juncticiliana*, though somewhat more variable, the dark markings shading from tawny red to reddish fuscous.

Palpus tawny red. Head and thorax rosy whitish to tawny red. Fore wing rosy whitish, minutely cross streaked with wavy lines of tawny red or dark reddish fuscous, and shading to a dark oblique central fascia outwardly margined by a white line (the latter usually somewhat angulate toward costa); postmedian area paler, shading to tawny red or dark reddish fuscous toward apex; in darker specimens the pale ground color is less obvious, the red more suffused, and there is a more or less defined dark angulate basal patch; termen edged by a black line; cilia of the ground color somewhat shaded with red. Hind wing smoky fuscous; cilia sordid whitish with a dark basal band.

Right harpe of male genitalia figured. Genitalia also figured in United States National Museum Bulletin No. 123 (fig. 155) over the name *juncticiliana*.

*Alar expanse*.—12–18 mm.

*Type and paratypes*.—Cat. No. 41210, U.S.N.M.; paratypes also in American Museum, Canadian National, and Barnes collections.

*Type locality*.—Tryon, N. C.

*Food plant*.—Solidago.

Described from male type from the type locality ("8-13-04, Fiske, collector"); one male paratype from Pummer Island, Md. (Busck, August, 1903); two male paratypes from Essex County Park, N. J. (Kearfott, "July 22" and "Aug. 13"); one male paratype from New Brighton, Pa. (Merrick, "VII-26-07"); one male paratype from Hampton, N. H. (S. A. Shaw, "VII-25-1911"); one male paratype from Hymers, Ontario ("July 8-15"); one male paratype from Kings County, Nova Scotia ("14-July-25"); one male paratype from Bilby, Alberta (O. Bryant, "July 12, 1924"); one male paratype from Fraser Mills, British Columbia (L. E. Marmont, "10-VIII-20"); two male paratypes from Hot Springs, Green River, Wash. ("July 8-15"); and one male paratype from Denver, Colo. (Oslar). These are from a large series of males and females in the National, American Museum, and Barnes collections from Massachusetts, New

Hampshire, New Jersey, Pennsylvania, Maryland, Virginia, North Carolina, Florida, Missouri, Colorado, Washington, British Columbia, Alberta, Manitoba, Ontario, and Nova Scotia.

Distinguished from *juncticiliana* Walsingham and *excusabilis* Heinrich chiefly by genitalia. The genitalic differences separating the three are shown in Figures 30, 31, and 32. (Note differences in shape of cucullus in *juncticiliana* and *excusabilis*, and the position of the sacculus spur and the peculiar spining of incurvate area (neck) of harpe in *derelicta*). Superficially *derelicta* is readily separable only on one character, the shape of the termen of fore wing. In *juncticiliana* and *excusabilis* this is a trifle convex, while in *derelicta* it is very slightly concave and somewhat less slanting.

EPIBLEMA SERANGIAS (Meyrick)

Two more specimens of the species are now before me. One of these (a male labeled, "Oslar, Chimney Gulch, Golden, Colo., July") is in the National collection. The other, also a male (labeled, "Oslar, Bear Creek, Morrison, collector"), is in the Barnes collection. The former shows a queer freak in venation, having veins 3 and 4 of hind wing connate rather than stalked. The latter is normal, and both agree with the type in other details of genitalia and pattern.

EPIBLEMA HIRSUTANA (Walsingham)

Figure 8

Two specimens, a male and female, sent to Fernald by Walsingham, are now in the National collection. Both are from California and the male is labeled "Type."

The species is very close to *infelix* Heinrich, but apparently distinct, differing in its smaller size, shorter costal fold (not reaching middle of wing), more incurvate neck of harpe, and weaker spining in area surrounding clasper.

Male genitalia figured.

EPIBLEMA PERICULOSANA Heinrich

One specimen (male) in collection Barnes, labeled "Davis Creek, Modoc County, Calif., A. W. Lindsey, June, 1922."

EPIBLEMA ABBREVIATANA (Walsingham)

A male in collection Barnes from Jemez Springs, N. Mex.

SONIA VOVANA (Kearfott)

Mr. George Englehardt has discovered the food plant of this species and reared a male which is now in the National collection. The adult was reared from larvae boring in the main stems of *Senecio filifolius* Nuttall, and collected by him in Canon, Ariz., in 1925. Moth issued August 25, 1925.

## EPINOTIA XANDANA (Kearfott)

I was in error in my revision of the Eucosminae (U. S. National Museum Bull. 123, 1923, p. 205) in placing this as a synonym of *vertumnana* Zeller. It is a good species. Kearfott's *yandana*, however, falls as a synonym of *xandana*, which latter name should replace that of *yandana* in couplet 36 of my key.

## EPINOTIA SUBVIRIDIS, new species

## Figure 22

A species of the *hopkinsana* group with costal fold, a pale yellowish green tint on the lighter areas of fore wing and the dark patches strongly margined with black lines.

Palpus, face, and head sordid creamy ochereous; third joint of palpus somewhat darker, exposed. Thorax ochereous with a faint greenish tinge. Fore wing with light areas pale greenish and dark patches smoky fuscous; an outwardly angulate dark basal patch more or less broken and suffused toward base with the pale ground color, and outwardly margined by a strong black line; a similar black angulate crossline just beyond base, and between it and outer black line of basal patch a black line extending from dorsum to cell, and on costa opposite it a black dot; on dorsum near tornus a subquadrate dark patch, its upper outer angle touching the lower inner angle of a similar subapical costal patch; edging the inner margin of the subternal patch and extending beyond it to mid costa, a strong black sinuate line; a similar, oppositely angulate black line edging the outer margin of the subternal and the inner margin of the subapical patches; ocelloid area with a narrow vertical line of ochereous scales dividing the pale ground color; similar pale ochereous slightly raised scales bordering the black lines, and a few obscure ochereous lines and dustings scattered over the pale areas of the wing; cilia pale smoky fuscous with a strong black basal line and with scale ends white; veins 3, 4, and 5 approximate at termen; termen concave. Hind wing very pale smoke color; cilia sordid whitish with a slightly darker basal band.

Male genitalia of type figured.

*Alar expanse*.—16–20 mm.

*Type and paratype*.—Cat. No. 41211, U.S.N.M.

*Paratypes*.—In American Museum and collections Barnes and Blackmore.

*Type locality*.—San Diego, Calif.

*Food plant*.—*Cupressus macrocarpa*.

Described from male type and female paratype from the type locality (July and August); one female paratype labeled, "6523, iss. 5 Apr. 95, on Monterey cypress, California, G. C. Brackett"; two female paratypes from Victoria, British Columbia ("16-VIII-21")

and "18-VIII-21," W. R. Carter, collector, Blackmore No. 481); and one female paratype from Fraser Mills, British Columbia (L. E. Marmont, "9-IX-1922," Blackmore No. 661).

The species is close to *hopkinsana* Kearfott, but readily distinguished by its stronger black lining, less distinctly green tint, stronger dark patches on fore wing, and its unforked uncus. In *hopkinsana* this organ is distinctly bifid.

EPINOTIA BASIPUNCTANA (Walsingham)

Figure 21

Two Walsingham specimens from the Fernald collection (a male and female labeled "Type") are now in the United States National Museum. The genitalia are like those of *sublicana* Walsingham except that the lateral arms of gnathos are less strongly chitinized.

Male genitalia of type figured.

EPINOTIA MARMOREANA Heinrich

*Epinotia marmoreana* HEINRICH, U. S. Nat. Mus. Bull. 123, 1923, p. 222.

In describing this species I overlooked a character which would place it in group A rather than B of the genus. The male has a strong appressed costal fold reaching well beyond the middle of fore wing. With this character it would follow *silvertoniensis* Heinrich in my arrangement.

EPINOTIA CRENANA (Hübner)

Five specimens from Sebec Lake, Me., are now in the National (two) and Barnes (three) collections. As far as I know, this is the first eastern North American record for this species.

EPINOTIA CERCOARPANA (Dyar)

Two specimens (male and female "June 8-15") from Paradise, Cochise County, Ariz., in collection Barnes.

EPINOTIA NONANA (Kearfott)

Figure 16

Several specimens from various Colorado localities are now before me. Male genitalia figured from specimen in collection Barnes labeled, "Sneffels Mts., Ouray County, Colorado, Oslar, August."

EPINOTIA SEORSA Heinrich

Figure 23

*Epinotia seorsa* HEINRICH, Journ. Washington Acad. Sci., vol. 14, No. 16, 1924, p. 392.

Male genitalia of type figured.

## ANCHYLOPERA TENEBRICA, new species

A dark fuscous species with unicolorous basal patch and outer dark band on fore wing and with the white basal area of costa somewhat obscured by dark dusting.

Palpus fuscous shaded with sordid white toward base and on inner side. Face, head, and thorax brownish fuscous. Fore wing with basal patch, outer dark band and tornal area fuscous brown more or less dusted with blackish brown; outer subcostal area paler brown; basal half of costa whitish gray with several fine dark brown dashes on costal edge and a slight dusting of dark scales on the whitish ground beneath, the pale costal area continuing as an obscure whitish gray band between basal patch and outer dark band to dorsum and thence in a curve above tornal dark area to termen near tornus; outer half of costa with eight strong white dashes, the inner one continued as a leaden metallic line along outer margin of outer dark band; at apex a prominent dark spot; cilia fuscous shading to dirty white at tornus and with a white subapical spot cut by a thin black line. Hind wing pale smoky fuscous; cilia slightly paler.

Male genitalia as in *spiraeifoliana* but smaller, nearly two-thirds size of those of *spiraeifoliana*.

*Alar expanse*.—12–13 mm.

*Type and paratype*.—Cat. No. 41212, U.S.N.M.; paratypes also in Canadian National and Bryant collections.

*Type locality*.—Bilby, Alberta, Canada.

*Food plant*.—Unknown.

Described from male type and three male paratypes from the type locality (O. Bryant, June 1, 1924, and June 12, 1924).

Close to *spiraeifoliana* Clemens. Distinguished by its darker color, less distinctly white basal costal area, and much smaller genitalia.

## ANCHYLOPERA MIRA, new species

A species of the *burgessiana-laciniana* group with fawn brown basal patch and a red outer bar on fore wing.

Palpus and face white. Head ochereous. Thorax fawn brown, paler (more ochereous) toward anterior margin; tegula white with slight ochereous shading. Fore wing with ground color bright ochereous; basal patch fawn brown with outer margin slanting; outer bar distinctly reddish and containing two black longitudinal streaks; base of costa white, unmarked; costa beyond outer bar marked by several reddish brown dashes interspaced with white and with a large reddish spot at apex; area between basal patch and outer bar of the ground color somewhat dusted with white; cilia pale ochereous with a white subapical spot broken by a slight black dash. Hind wing very pale smoky fuscous, almost white in some specimens; cilia white.

Male genitalia as in *burgessiana*.

*Alar expanse*.—13–15 mm.

*Type and paratypes*.—Cat. No. 41213, U.S.N.M.; also paratypes in American Museum, Canadian National, and Barnes collections.

*Type locality*.—Chimney Gulch, Golden, Colo. (Oslar).

*Food plant*.—Unknown.

Described from male type, female paratype, and four male paratypes from the type locality, dated "April" (type and three other males), "6-14-07" (female) and "7-15-04" (one male); one male paratype from Clear Creek, Colo. (Oslar, "5-30-07"); and one female paratype from Denver, Colo. (Oslar, "6-14-04").

Besides the above I have before me specimens from St. Johns, Quebec (W. Chagnon, "3-VI-14," male without abdomen), Palos Park, Chicago, Ill. (A. Kwiat, "VI-4-04," male without abdomen), New Hampshire (male, no date), Wisconsin (male, no date), and Vavenby, British Columbia (Theo. A. Moilliet, "22-V-1924," Blackmore No. 797, male).

This is the form to which I referred in my revision of the Eucosminae (U. S. National Museum Bull. 123, p. 242) as a possible variety of *platanana* Clemens. I am inclined now to believe that it is a good species, closer if anything to *burgessiana* than to *platanana*.

ANCHYLOPERA MIRA FURVESCENS, new variety

A dark variety and presumably a food plant race of the preceding species. Ground color of fore wing more suffused with fuscous, especially in terminal area; basal patch very dark brown; outer bar dark red and more diffused, the red blending into the fuscous of the terminal area, which has none of the contrasted yellow color of typical *mira*. Hind wing smoky fuscous; cilia slightly paler, sordid.

Genitalia as in typical *mira*.

*Alar expanse*.—12.5–14 mm.

*Type*.—In American Museum.

*Paratypes*.—Cat. No. 41214, U.S.N.M.; also in Canadian National and Barnes collections.

*Type locality*.—New Haven, Conn.

*Food plant*.—Unknown.

Described from male type from the Kearfott collection of the American Museum ("VI-10"); one female paratype from the Fernald collection without locality label; two female paratypes from New Hampshire (one from Dublin, August Busck, collector; the other with only the New Hampshire label); and one female paratype from Quebec (A. W. Hanham "266").

In color much like the European *derasana* Hübner.



## ANCYLIS ALBAFASCIA, new species

Figure 5

A dark brown species with a narrow white transverse fascia on fore wing from costa before middle to outer third of dorsum.

Palpus white, shaded with pale fuscous on outer side and toward apex. Head and thorax glossy fuscous brown. Fore wing very dark brown; costa with two pairs of short white dashes before middle and four pairs on outer half; from the first pair of antimedial costal dashes a narrow but somewhat irregular band of white scales extends to outer third of dorsum, forming to the naked eye a thin white transverse fascia; no ocelloid patch; in terminal area a couple of very obscure, thin, semimetallic curved bands continue from the first and second postmedian pair of white costal dashes (not visible except under magnification); some faint white scaling at termen near tornus; cilia shining metallic fuscous with a couple of strong white dashes below apex, at extreme apex of the general wing color. Hind wing dark brown, but slightly paler than fore wing; cilia paler with a dark basal band, the scale ends toward apex whitish.

Male genitalia figured from type.

*Alar expanse*.—11-14 mm.

*Type*.—In Barnes collection.

*Paratypes*.—Cat. No. 41215, U.S.N.M.; also in American Museum and Barnes collections.

*Type locality*.—Mineralking, Tulare County, Calif.

*Food plant*.—Unknown.

Described from male type, four male and three female paratypes from the type locality ("June 24-30" and "July 1-7"); one male paratype and two female paratypes from San Bernardino, Calif. ("June 1-7").

A distinct species, not to be confused with anything else in the genus. In genitalia nearest to *unquicella* Linnaeus, which species it precedes in my arrangement, but with much slenderer harpes.

## HYSTRICOPHORA OCHREICOSTANA (Walsingham)

Figure 29

In a paper published in the Journal of the Washington Academy of Sciences (vol. 14, No. 16, 1924, p. 393) I expressed the opinion that *ochreicostana* was nothing but a variety of *taleana* Grote. I had noted the differences in the harpes of the two and the color differences on basal half of costa of fore wing, but had overlooked entirely a very striking character in the tergite of the eighth abdominal segment. In *taleana* this part is distinctly excavate, while in *ochreicostana* it is produced as a blunted triangle (compare figs. 27, 29). Such

differences are more than can be expected between varieties; and the two (*taleana* and *ochreicostana*) must be held as distinct species.

The type of *taleana* (or what remains of it, two detached fore wings on card mounts) is in the Fernald collection of the United States National Museum, and not in the British Museum as I had written.<sup>1</sup>

**HYSTRICOPHORA LORICANA (Grote)**

Figures 24, 26

*Phoxopterus loricana* GROTE, Can. Ent., vol. 12, 1880, p. 218.

*Ancylis loricana* (Grote) FERNALD, in Dyar List N. Amer. Lepid., No. 5265.—

BARNES and McDUNNOUGH, Check List Lepid. Bor. Amer., No. 7202, 1917.—HEINRICH, U. S. Nat. Mus. Bull. No. 123, 1923, p. 253.

The acquisition by the United States National Museum of the Fernald collection has enabled me to make a genitalia slide of the type and only available specimen of this species, and to place it where it properly belongs, in *Hystricophora* rather than *Ancylis*. In pattern and coloration it fits nicely with *taleana*, *ochreicostana* and *decorosa*, the four forming a compact group of similarly marked but very distinct and easily recognized species.

**HYSTRICOPHORA DECOROSA, new species**

Figures 25, 28

Similar to the foregoing but much darker, with more restricted orange-yellow costal marking, differently shaped unspined tergite of eighth abdominal segment (compare figs. 26, 28), and differently shaped harpes. In *loricana* they are symmetrical and the ventral element of the divided harpe is very broad (roughly triangular) while in *decorosa* they are asymmetrical and the ventral element is very narrow and elongate (compare figs. 24, 25).

Antenna with basal joint black; ocherous beyond. Palpus sordid ocherous, shading to fuscous at apex. Head, thorax, and fore wing semilustrous blackish fuscous; on costa of fore wing near apex a conspicuous triangular orange colored spot, bordered inwardly by a narrow dull metallic band extending from outer fourth of costa to termen below apex and broken by three pale costal dashes interspaced with black; the two inner dashes sordid whitish ocherous and the apical dash clear white; a somewhat larger orange blotch occupying area between ocelloid patch and termen; ocelloid patch consisting of two short black dashes between two short obscure metallic vertical bars; termen edged by a fine black line; cilia lustrous, dark, nearly concolorous with ground color of wing. Hind wing concolorous with fore wing; cilia but very little paler.

Harpes of male genitalia and tergite of eighth abdominal segment figured from type.

<sup>1</sup> Journ. Wash. Acad. Sci., vol. 14, 1924, p. 393.

*Alar expanse*.—13–15 mm.

*Type*.—Cat. No. 41216, U.S.N.M.

*Paratype*.—In American Museum.

*Type locality*.—"Enterprise, Florida."

*Food plant*.—Unknown.

Described from male type and one male paratype from the type locality (P. Laurent, collector, "4-16" and "4-17"); the former from the Fernald collection and the latter from the American Museum.

The addition of this species and *loricana* to the genus and the changes that have been made since the publication of my revision of the Eucosminae make it necessary to amend the specific key given in that paper. The amended key follows:

KEY TO THE SPECIES OF HYSTRICOPHORA

1. Fore and hind wings both white ..... *vestaliana* (Zeller).  
Fore and hind wings not both white; if fore wing white, hind wing fuscous or dark brown ..... 2
2. Outer part of costa and terminal area of fore wing strongly marked and shaded with bright orange yellow ..... 3  
Outer part of costa and terminal area not so marked ..... 6
3. Head bright orange yellow ..... 4  
Head blackish or bronzy fuscous ..... 5
4. Basal half of fore wing yellowish, lighter than ground color of wing.  
*ochreicostana* (Walsingham).  
Basal half of fore wing not yellowish, of the ground color... *taleana* (Grote).
5. Head, thorax, and ground color of fore wing bronzy fuscous, shining.  
*loricana* (Grote).  
Head, thorax, and ground color of fore wing blackish fuscous, semilustrous.  
*decorosa* (Heinrich).
6. Fore wing white, whitish gray, whitish ocherous, or pale brownish gray... 7  
Fore wing ocherous brown, dull golden ocherous, golden fawn, or pale saffron ..... 10
7. Ground color of fore wing sordid whitish ocherous..... *roessleri* (Zeller).  
Ground color of fore wing white, whitish gray, or pale brownish gray.... 8
8. A well-contrasted pale spot near tornus; paler than rest of wing.  
*ostentatrix* Heinrich.  
No such contrasted pale spot near tornus; tornus at least no paler than ground color..... 9
9. Fore wing grayish white, blotched on dorsal half with brownish; cilia of hind wing with dark basal band..... *asphodelana* (Kearfott).  
Fore wing nearly pure white; cilia of hind wing without dark basal band.  
var. *seraphicana* Heinrich.
10. Ground color of fore wing ocherous brown, more brown than yellow, nowise golden..... 11  
Ground color of fore wing more golden than brown..... 12
11. Fore wing without ocelloid markings above tornus..... *stygiana* (Dyar)  
Fore wing with two or three short fine black dashes above tornus.  
var. *californiae* Heinrich.
12. Costa of fore wing straight from before middle of apex... *paradisiae* Heinrich.  
Costa of fore wing slightly arched before apex ..... 13
13. Fore wing a dull golden fawn color..... *leonana* Walsingham.  
Fore wing a pale golden saffron color..... *aurantiana* Walsingham.

## EXPLANATION OF PLATES

The drawings accompanying this paper were made under the author's supervision by Miss Mary Foley, of the Bureau of Entomology. The photographs were taken by Mr. J. G. Pratt, of the Bureau of Entomology.

## PLATE 1

## Male genitalia (Eucosminae)

- FIG. 1. *Thiodia insignata* Heinrich.  
 2. *Thiodia latens* Heinrich.  
 3. *Thiodia pastigiata* Heinrich.  
 4. *Thiodia bucephaloides* (Walsingham).  
 5. *Ancyliis alba* Heinrich.  
 6. *Thiodia parvana* (Walsingham).  
 7. *Thiodia lepidana* (Walsingham).  
 8. *Epiblema hirsutana* (Walsingham).

## PLATE 2

## Male genitalia (Eucosminae)

- FIG. 9. *Eucosma dapsilis* Heinrich.  
 10. *Eucosma shastana* (Walsingham).  
 11. *Eucosma eburata* Heinrich.  
 12. *Eucosma fandana* Kearfott.

## PLATE 3

## Male genitalia (Eucosminae)

- FIG. 13. *Eucosma perpropinqua* Heinrich.  
 14. *Eucosma persolita* Heinrich.  
 15. *Eucosma nuntia* Heinrich.  
 16. *Epinotia nonana* (Kearfott).

## PLATE 4

## Male genitalia (Eucosminae)

- FIG. 17. *Eucosma inquadrana* (Walsingham).  
 18. *Eucosma junctiliana* (Walsingham).  
 19. *Eucosma mirosignata* Heinrich.  
 20. *Eucosma russeola* Heinrich.  
 21. *Epinotia basipunctana* (Walsingham).  
 22. *Epinotia subviridis* Heinrich.  
 23. *Epinotia seorsa* Heinrich.  
 24. *Hystriophora loricana* (Grote).

## PLATE 5

## Structural characters (Eucosminae)

- FIG. 25. *Hystricophora decorosa* Heinrich; harpes of male genitalia.  
26. *Hystricophora loricana* (Grote); dorsal tergite of eighth abdominal segment.  
27. *Hystricophora taleana* (Grote); dorsal tergite of eighth abdominal segment.  
28. *Hystricophora decorosa* Heinrich; dorsal tergite of eighth abdominal segment.  
29. *Hystricophora ochreicostana* (Walsingham); dorsal tergite of eighth abdominal segment.  
30. *Eucosma derelicta* Heinrich; right harpe of male genitalia.  
31. *Eucosma excusabilis* Heinrich; right harpe of male genitalia.  
32. *Eucosma junciciliana* (Walsingham); right harpe of male genitalia.







1 *insignata*



5 *albafascia*



2 *latens*



6 *parvana*



3 *pastigiata*



7 *lepidana*



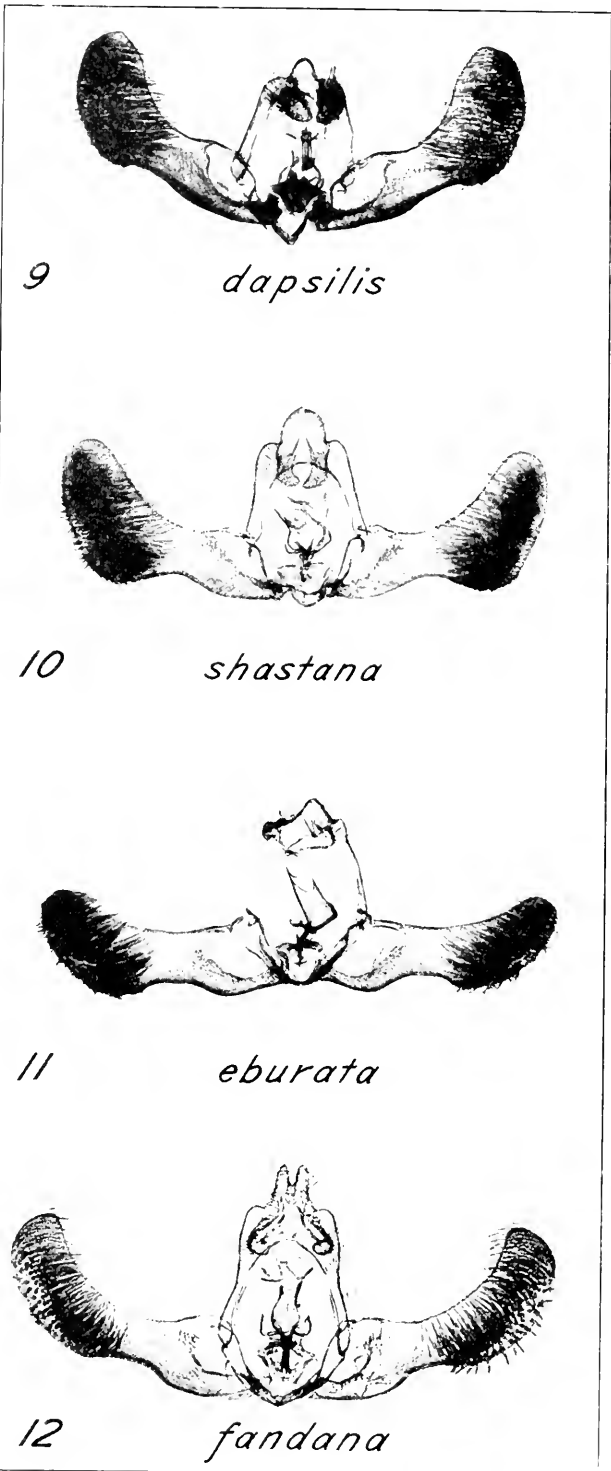
4 *bucephaloides*



8 *hirsutana*

MALE GENITALIA OF EUCOSMINAE

FOR EXPLANATION OF PLATE SEE PAGE 22



MALE GENITALIA OF EUCOSMINAE

FOR EXPLANATION OF PLATE SEE PAGE 22





13 *perpropinqua*



14 *persolita*



15 *nuntia*



16 *nonana*



17 *inquadrana*



21 *basipunctana*



18 *juncticiliana*



22 *subviridis*



19 *mirosignata*



23 *seorsa*



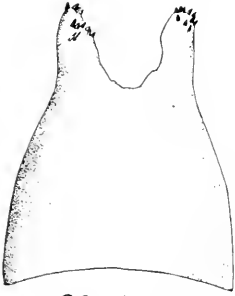
20 *russeola*



24 *loricana*



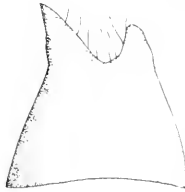
25 *decorosa*



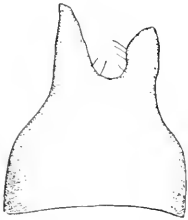
26 *loricana*



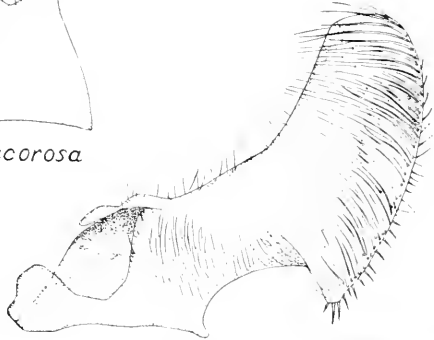
30 *derelicta*



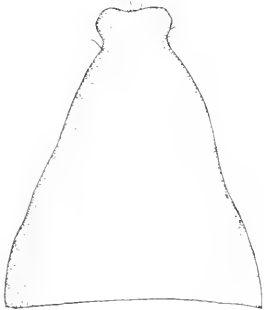
28 *decorosa*



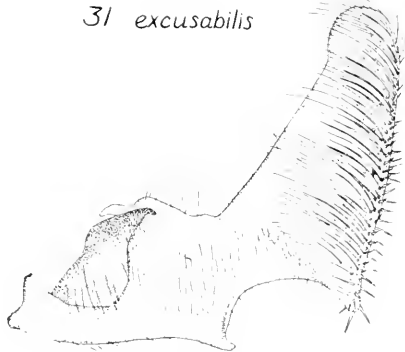
27 *taleana*



31 *excusabilis*



29 *ochreicostana*



32 *juncticiliana*

STRUCTURAL CHARACTERS OF EUCOSMINAE

FOR EXPLANATION OF PLATE SEE PAGE 23



# RECENT FORAMINIFERA FROM OFF JUAN FERNANDEZ ISLANDS

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Research, Sharon, Mass.*

During his cruise about South America, Dr. Waldo Schmitt collected foraminifera from a number of interesting localities. Among these is a collection of material taken by means of a "bull-dog" snapper from shallow water 10-20 fathoms, in Cumberland Bay, Juan Fernandez Island, Chile. This represents a region very little known as far as the foraminifera are concerned. Since d'Orbigny's classic memoir published in 1839<sup>1</sup> almost no records are known from the west coast of South America or adjacent islands. The *Challenger* cruised in this region and the *Albatross* made a trip about South America on which a few samples were collected, but these have not been worked up for their contained foraminifera. The *Challenger* dredged in the vicinity of Juan Fernandez but only in very deep water so that the records have little in common with this shallow-water material.

The fauna is interesting on account of its association with other regions. Some of the species are evidently East Indian or Australian in their relationship, such as *Spirillina spinigera*, *Patellina advena*, *Tretomphalus bulloides*, etc. Others seem to be more closely related to colder water faunas such as are known from the west coast of North and South America represented by such species as *Gaudryina triangularis*, *Sigmoidella (Sigmoidina) pacifica*, *Elphidium articularia*, *Bulimina patagonica*, *Angulogerina carinata*, and others. There are a few representatives of pelagic species such as *Globigerina conglomerata*, *G. inflata*, *G. triloba*, *Globorotalia menardii*, and *G. truncatulinoides*.

Some of the species are represented by too few specimens to allow a full description and identification. Some of these are, however, of sufficient interest so that figures are here given for future reference. Several of the species have proved to be new. The figures on the

<sup>1</sup> Voy. Amér. Mérid., 1839, Foraminifères.

plates are from carefully made camera lucida drawings and have sufficient detail so that it is hoped the characters of the specimens of the collection will be adequately given. Descriptions of the species follow.

### Family TEXTULARIIDAE

#### Genus GAUDRYINA d'Orbigny, 1839

##### GAUDRYINA TRIANGULARIS Cushman

Plate 1, figures 1 *a, b*

*Gaudryina triangularis* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 65, fig. 104 (in text); Bull. 163, U. S. Nat. Mus., 1918, p. 56, pl. 20, fig. 3; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 604; Publ. 291, Carnegie Inst. Washington, 1919, p. 35; Bull. 109, U. S. Nat. Mus., vol. 4, 1921, p. 148; U. S. Geol. Survey, Prof. Paper 129 F., 1922, p. 127; Prof. Paper 133, 1923, p. 21, pl. 3, fig. 5; Bull. Scripps Inst. Oceanography, Tech. Ser., vol. 1, 1927, p. 138.

Test slightly longer than broad, for the most part triangular, the angles subacute, early chambers triserially arranged, later ones biserial, few; wall coarsely arenaceous, smoothly finished; aperture a narrow slit at the inner margin of the last-formed chamber.

Length 0.35 mm.

### Family MILIOLIDAE

#### Genus QUINQUELOCULINA d'Orbigny, 1826

##### QUINQUELOCULINA VULGARIS d'Orbigny

Plate 1, figures 7 *a-c*

*Quinqueloculina vulgaris* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 302. — TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 1, 1878, p. 66, pl. 6 (11), figs. 20*a-21*.

There are a few specimens in the collection similar to that figured which may be referred to this species of d'Orbigny. The wall shows a few longitudinal costae.

##### QUINQUELOCULINA LAEVIGATA d'Orbigny

Plate 1, figures 4 *a-c*

*Quinqueloculina laevigata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 301; in BARKER, WEBB and BERTHELOT, Hist. Nat. Îles Canaries, 1839, vol. 2, pt. 2 "Foraminifères," p. 143, pl. 3, figs. 31-33.

A few specimens with smooth surface and general shape as that given on Plate 1, figure 4, are referred to this species of d'Orbigny. From the records, this species seems to have a very wide range, but this is probably due to its smooth surface and lack of more definite characters.

Length 0.27 mm., breadth 0.13 mm.

## QUINQUELOCULINA PUNCTULATA d'Orbigny (?)

Plate 1, figures 2 a-c

*Quinqueloculina punctulata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 302.

Some authors have referred to this species forms similar to those figured (Pl. 1, figs. 2 a-c). The surface is smooth or finely pitted but not conspicuously so, and the chambers are decidedly angled.

## QUINQUELOCULINA DURANDI, new species

Plate 1, figures 5 a-d

Test small, short and broad, only slightly longer than broad in front view; periphery rounded or somewhat truncate; chambers distinct, slightly inflated; sutures distinct, slightly depressed, sinuate; wall thin, ornamented with longitudinal costae slightly raised and irregular in size and often irregularly sinuate; aperture large, with a large flat tooth.

Length 0.25 mm., breadth 0.20 mm., thickness 0.14 mm.

*Holotype*.—(Cat. No. 20775, U.S.N.M.) from Cumberland Bay, Juan Fernandez, collected by Dr. Waldo Schmitt. The species has been named for Señor René Durand, a resident of Juan Fernandez, in appreciation of the generous hospitality and unstinted assistance extended Doctor Schmitt during his sojourn on the island.

This is a peculiar small species but seems to be rather constant in its somewhat unusual characters.

## Genus TRILOCULINA d'Orbigny, 1826

## TRILOCULINA GRACILIS d'Orbigny

Plate 1, figures 3 a-c

*Triloculina gracilis* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 181, pl. 11, figs. 10-12.—CUSHMAN, Publ. 311, Carnegie Inst. Washington, 1922, p. 74.

Test elongate, slender, triloculine; chambers rounded; sutures very slightly depressed; apertural end extended into a cylindrical neck, the outer end of which is enlarged and has a phialine lip; surface smooth or very finely striate; aperture circular, with a slight tooth.

Length 0.40 mm., breadth 0.13 mm., thickness 0.08 mm.

This species was described by d'Orbigny as rare from shore sands of Cuba and Jamaica. It is recorded from four stations in the Tortugas region. It is a very slender, thin-walled species, and most easily distinguished by the characters of the aperture. The figured specimen shows fairly well the general characters of the species.

## TRILOCULINA ROTUNDA d'Orbigny

Plate 2, figures 2 a-c

*Triloculina rotunda* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 299.—SCHLUMBERGER, Mém. Soc. Zool. France, vol. 6, 1893, p. 64, pl. 1, figs.

48-50; figs. 11, 12 (in text).—CUSHMAN, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 639; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 460; U. S. Geol. Survey, Prof. Paper 133, 1923, p. 57, pl. 8, figs. 6, 7; Publ. 344, Carnegie Inst. Washington, 1926, p. 82.

*Miliolina rotunda* MILLETT, Journ. Roy. Micr. Soc., 1898, p. 267, pl. 5, figs. 15, 16.—HERON-ALLEN and EARLAND, Trans. Micr. Soc. London, vol. 20, 1915, p. 568, pl. 42, figs. 27-30.

Test somewhat longer than wide; chambers distinct, somewhat inflated; periphery broadly rounded; sutures very slightly depressed, distinct; wall smooth, polished, occasionally with transverse wrinkles; apertural end somewhat contracted with a slightly thickened lip, the aperture itself rounded with a single bifid tooth projecting somewhat above the outline of the aperture.

Length 0.85 mm., breadth 0.60 mm.

This species apparently has a very wide distribution as it is recorded from the Mediterranean, the West Indian region, and from the Indo-Pacific.

TRILOCULINA CRASSA (?) (d'Orbigny)

Plate 2, figures 1 a-c

To this species are referred a few specimens with smooth surface or very slightly costate of the form shown in the figure.

TRILOCULINA SUBROTUNDA (Montagu) (?)

Plate 1, figures 6 a-c

There are a few rather small specimens which although they are triloculine fit rather closely the characters given for this species. In some respects they resemble *Triloculina circularis* Bornemann but are not in the usual form of that species.

Family OPHTHALMIDIIDAE

Genus CORNUSPIRA Schultze, 1854

CORNUSPIRA INVOLVENS (Reuss)

Plate 2, figure 3

*Operculina involvens* REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 370, pl. 46, fig. 30.

*Cornuspira involvens* REUSS, Sitz. Akad. Wiss. Wien, vol. 48, Abt. 1, 1863, p. 39, pl. 1, fig. 2; vol. 50, Abt. 1, 1864, p. 450.

Test nearly circular in side view, consisting of a proloculum and a long closely coiled, planispiral second chamber of nearly equal diameter throughout, slightly involute; suture distinct, somewhat depressed; wall smooth and polished, occasionally showing slight lines of growth; aperture nearly the size of the open end of the tube.

Diameter 0.45 mm.

There are a few specimens of this simple, widely distributed species in the material examined.



## Family FISCHERINIDAE

## Genus FISCHERINA Terquem, 1878

## FISCHERINA DUBIA (d'Orbigny)

Plate 2, figures 4 a-c

*Rotalina dubia* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 91, pl. 2, figs. 29, 30.

*Fischerina dubia* CUSHMAN, Publ. 311, Carnegie Inst. Washington, 1922, p. 59, pl. 10, figs. 6, 7.

Test composed of a few coils, the early portion undivided, the last-formed coil divided usually into four chambers or sometimes five, all visible from the dorsal side, only those of the last-formed coil from the ventral side as the chambers on that side are completely involute, ventral side somewhat concave, dorsal side slightly convex; sutures distinct but not depressed; wall thin, translucent, of a milky-white color; aperture at the end of the last-formed chamber, circular, or the inner portion somewhat flattened.

Diameter 0.40 mm., thickness 0.15 mm.

This species was described from Cuba by d'Orbigny, and has also been recorded from the Tortugas region. It also resembles closely *Fischerina helix* Heron-Allen and Earland, but does not have the spire of that species.

## Family TROCHAMMINIDAE

## Genus CARTERINA H. B. Brady, 1884

## CARTERINA FULVA Cushman

Plate 2, figures 6 a-c

*Carterina fulva* CUSHMAN, Publ. 342, Carnegie Inst. Washington, 1924, p. 10, pl. 1, fig. 3.

Test rotaliform, slightly longer than broad, compressed; chambers 5-8 in the last-formed coil; sutures distinct but not depressed on the dorsal side, slightly depressed on the ventral side, curved; wall very thin, translucent, composed largely of fusiform bodies, irregularly arranged; aperture on the ventral side toward the umbilicus; color yellowish-brown throughout.

Length 0.26 mm., breadth 0.22 mm., thickness 0.08 mm.

This species was originally described from Samoa and it is interesting to find it ranging further to the east to Juan Fernandez. It is to be suspected that the species also occurs as far westward as the east coast of Africa.

## Family LAGENIDAE

## Genus LENTICULINA Lamarck, 1804

## LENTICULINA CONVERGENS (?) Bornemann

Plate 2, figures 5 a, b

There are a very few specimens of the form figured which are of the general appearance of specimens usually referred to this species of Bornemann.

## Genus MARGINULINA d'Orbigny, 1826

## MARGINULINA species ?

Plate 3, figures 1 a-c

There is a single megalospheric specimen somewhat irregular in shape which it has not seemed wise to definitely name at the present time. A figure of it is given for future reference.

## Genus NODOSARIA Lamarck, 1812

## NODOSARIA SUBSTRIATULA Cushman

Plate 3, figures 2, 3

*Nodosaria subcanaliculata* H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 512, pl. 64, figs. 23, 24 (not *Dentalina subcanaliculata* Neugeboren).

*Nodosaria substriatula* CUSHMAN, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 655; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 204, pl. 36, figs. 8, 9; pl. 52, figs. 7-9.

Test usually consisting of four chambers, the proloculum with a globular body, an apical spine, and with definite longitudinal costae; the second chamber much more elongate, flask shaped, with a long neck, when partially covered by the third chamber becoming subcylindrical, ornamented like the proloculum; third chamber still more elongate, with a long neck, the surface ornamentation consisting of short, broken, longitudinal striae; the fourth chamber similar but remote, a large part of the neck between the two chambers visible; final chamber with the apertural neck long and slender, smooth; the apertural end with four or more flangelike costae extending up and beyond the aperture and incurving somewhat over the aperture.

Length 0.45 mm., diameter 0.15 mm.

It is interesting to find this distinct species which is known to have an Indo-Pacific distribution so far from the other records. No adult with the four chambers was found, but the specimens with three chambers figured here seem to be typical.

## Genus LAGENA Walker and Jacob, 1798

## LAGENA STRIATA (Montagu)

Plate 3, figures 4 a, b

The form figured here is rare in the collection, and may be referred to this species.

## LAGENA LAEVIGATA (?) Reuss

Plate 3, figures 5 a, b

The form figured sometimes has very slight striae near the base, and the aperture as shown is not entirely symmetrical.

## LAGENA species ?

Plate 3, figures 6 *a*, *b*

This form is a peculiar one in the ridges at the base. It is somewhat complex and has a thickened band along the periphery; the aperture is elongate, elliptical.

## Family POLYMORPHINIDAE

Genus SIGMOIDELLA Cushman and Ozawa, 1928

SIGMOIDELLA (SIGMOIDINA) PACIFICA Cushman and Ozawa

Plate 3, figures 7 *a*, *b*

*Sigmoidella (Sigmoidina) pacifica* CUSHMAN and OZAWA, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 19, pl. 2, fig. 13.

Test small, involute, somewhat compressed, few chambers visible from the exterior, ovate, the greatest breadth below the middle; chambers few, distinct, the last-formed one somewhat angled at the periphery; sutures distinct, very slightly depressed; wall smooth, translucent; aperture radiate, terminal.

Length 0.43 mm., breadth 0.32 mm., thickness 0.14 mm.

The type of this species is from the China Sea, near Formosa. It is interesting to find this species so far from its original locality, although its known distribution is wide in the Pacific.

## Family NONIONIDAE

Genus ELPHIDIUM Montfort, 1808

ELPHIDIUM ARTICULATUM d'Orbigny, RUGULOSUM, new variety

Plate 3, figures 8 *a*, *b*

Test bilaterally symmetrical, umbilicate, somewhat compressed, periphery rounded; about nine chambers in the last-formed coil, slightly inflated; sutures slightly depressed, gently curved, somewhat filled with a rugose secondary growth which, over the umbilical region, fills that area, wall otherwise smooth, finely perforate; aperture consisting of an arched opening in the median line and a few smaller supplementary openings at either side.

Diameter 0.30 mm., thickness 0.12 mm.

*Holotype of variety*.—(Cat. No. 20782, U.S.N.M.) from off Juan Fernandez, collected by Dr. Waldo Schmitt.

This variety differs from the species described by d'Orbigny in the peculiar ornamentation of the sutures and the umbilical regions, and also in the aperture. The general shape and number of chambers is very similar to d'Orbigny's species.

ELPHIDIUM SCHMITTI, new species

Plate 3, figures 9 *a-c*

Test bilaterally symmetrical, slightly compressed; periphery broadly rounded; about seven chambers in the last-formed coil, inflated;

sutures distinct, depressed, slightly curved, marked by a few small retral processes; wall smooth, finely perforate except the umbilical regions which are covered by a coarsely granular ornamentation; apertures consisting of three or more small rounded openings at the base of the last-formed chamber close to the median line.

Diameter 0.36 mm., thickness 0.15 mm.

*Holotype*.—(Cat. No. 20776, U.S.N.M.) from Juan Fernandez, collected by Dr. Waldo Schmitt.

This is an interesting species especially in the ornamentation of the umbilical regions.

ELPHIDIUM species

Plate 3, figures 10 *a, b*

This species figured on Plate 3, figure 10 is not given a name as further specimens should be studied to determine its exact relationships. It is noted here for future reference.

Family BULIMINIDAE

Genus BULIMINELLA Cushman, 1911

BULIMINELLA ELEGANTISSIMA (d'Orbigny)

Plate 3, figures 12 *a, b*

*Bulimina elegantissima* d'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 51, pl. 7, figs. 13, 14.

*Buliminella elegantissima* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 89.

This species was described by d'Orbigny from the west coast of South America where he had specimens from several stations from Peru to Chile. There have been numerous forms referred to this species from various parts of the world both fossil and recent. Our specimens from Juan Fernandez are of the slender form figured by d'Orbigny from his types.

Genus BULIMINA d'Orbigny

BULIMINA PATAGONICA d'Orbigny

Plate 3, figures 11 *a, b*

*Bulimina patagonica* d'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 50, pl. 1, figs. 8, 9.

There are a few specimens which may be referred to this species. They are elongate, fusiform, the last few chambers smooth, the earlier ones marked by short spines both on the border of the chamber and some on the chamber faces. It seems best referred to this species of d'Orbigny which he described in his South American work. It somewhat resembles *Bulimina marginata*, but seems to be distinct.

**BULIMINA PATAGONICA** d'Orbigny, *GLABRA*, new varietyPlate 4, figures 1 *a-c*

Test broadest near the apertural end and much like d'Orbigny's figure of *Bulimina patagonica*, except that the ornamentation at the base of the chambers is wanting.

*Holotype of variety*.—(Cat. No. 20777, U.S.N.M.), collected by Dr. Waldo Schmitt in material from off Juan Fernandez.

**Genus VIRGULINA** d'Orbigny, 1825**VIRGULINA SCHREIBERSIANA** CzjzekPlate 4, figures 2 *a, b*

There have been very many forms referred to this species which have no surface ornamentation, and the chambers rather irregularly arranged. The specimens fit Czjzek's species as closely as do many others, and it has seemed best to leave them under his name.

**Genus BOLIVINA** d'Orbigny, 1839**BOLIVINA DONIEZI**, new speciesPlate 4, figures 3 *a, b*

Test small, depressed, broadest near the apertural end; chambers comparatively few, consisting of 8 or 10 pairs; wall very coarsely perforate, the earlier chambers with a few coarse perforations near the basal margin, the adult chambers with the coarse perforations scattered over the general surface; chambers fairly narrow, but becoming higher toward the apertural end; sutures distinct, depressed, strongly oblique; aperture elongate, arched, in the median line at the base of the last-formed chamber.

Length 0.36 mm., breadth 0.15 mm., thickness 0.10 mm.

*Holotype*.—(Cat. No. 20778, U.S.N.M.) from material collected by Doctor Schmitt from off Juan Fernandez. The species has been named for Señor Doniez of the firm Recart & Doniez, concessionaires of the principal lobster fishery on the island.

This species from other records is probably widely distributed in the Indo-Pacific region.

**BOLIVINA SUBEXCAVATA**, new speciesPlate 4, figures 4 *a, b*

Test small, broadest near the apertural end, from which it rapidly tapers to the initial end; periphery rounded; chambers few, consisting of six or eight pairs, the earlier ones broad and low, the later ones increasing in height toward the apertural end; sutures distinct, depressed, slightly oblique; wall very coarsely perforate, with two regions, one at either side of the central area, which is excavated; aperture, an arched indentation at the base of the last-formed chamber in the median line.

Length 0.32 mm., breadth 0.18 mm., thickness 0.12 mm.

*Holotype*.—(Cat. No. 20779, U.S.N.M.) from off Juan Fernandez, collected by Dr. Waldo Schmitt.

This is a peculiar small form especially marked by the coarse perforations and the two distinct ridges close to the median line. It is somewhat similar to a species which occurs off the European coast and has often been known as *Bolivina plicata* d'Orbigny, although it is not that species. *Bolivina subexcavata* apparently has a wide range in the South Pacific from other records and material that we have.

**BOLIVINA cf. KARRERIANA** H. B. Brady, var. **CARINATA** Millett

Plate 4, figure 5

This species which is figured is much compressed, has numerous chambers which are low and broad with strongly oblique sutures, and all but the last chambers ornamented, with a few distinct longitudinal costae and the periphery subacute. It is not entirely typical of Millett's variety, but may be left under that name until more is known concerning it.

**Genus LOXOSTOMUM** Ehrenberg, 1854

**LOXOSTOMUM cf. MAYORI** (Cushman)

Plate 4, figures 6 a-c

This small, somewhat irregular specimen belongs in this genus, as the aperture is terminal and away from the edge of the last-formed chamber. The wall is finely perforate and the earlier portion has traces of fine longitudinal costae. *L. mayori* has a wide distribution, and this may be a somewhat irregular form of it.

**Genus UVIGERINA** d'Orbigny, 1826

**UVIGERINA VIRGULINOIDES**, new species

Plate 4, figures 8 a-c

Test elongate, broadest toward the apertural end, the early portion triserial, later portion irregularly biserial and twisted; chambers numerous, inflated, the last-formed ones forming a somewhat compressed test; sutures distinct, depressed; wall smooth, finely perforate, thin; aperture terminal with a short tubular neck and sometimes with a slight lip.

Length 0.25 mm., breadth 0.10 mm., thickness 0.07 mm.

*Holotype*.—(Cat. No. 20780, U.S.N.M.), collected by Doctor Schmitt in his material from Juan Fernandez.

This is a peculiar species with the last-formed portion becoming distinctly biserial. It resembles somewhat irregular forms of *Virgulina*, but it has the distinct characters of *Uvigerina*. There are a number of specimens all of this same form, showing that it is not an abnormally shaped specimen. There are a few other species of this genus which become depressed and biserial, mostly in the late Tertiary of the Mediterranean region.

Genus **ANGULOGERINA** Cushman, 1927**ANGULOGERINA CARINATA** CushmanPlate 4, figures 7 *a-d*

*Angulogerina carinata* CUSHMAN, Bull. Scripps Inst. Oceanography, Tech. Ser., vol. 1, 1927, p. 159, pl. 4, fig. 3.

Test generally triangular in section, initial end bluntly rounded; chambers few, distinct, the three sides flattened, the angles sharply carinate, often with fine radial tubules; sutures distinctly depressed; wall thick, opaque, mostly smooth but with traces of some longitudinal costae.

This species was described from recent material from off the west coast of America. It is interesting to note that Brady in the *Challenger* Report (pl. 74, fig. 18) figures this species under another name from north of Juan Fernandez in deep water.

Family **ROTALIIDAE**Genus **SPIRILLINA** Ehrenberg, 1841**SPIRILLINA VIVIPARA** Ehrenberg, varietyPlate 4, figures 9 *a, b*

There are a few specimens of a form of *Spirillina* in which the later coils are coarsely perforate as in the typical form of the species, but the earlier coils are somewhat ornamented by radial lines. Such forms are recorded from the South Pacific under various names by Sidebottom, Chapman, and others.

**SPIRILLINA SPENIGERA** Chapman, varietyPlate 5, figures 1 *a-c*

The figured specimen shows the characters of this form, which may be considered a variety of Chapman's species. One side is flattened and covered by a rugose ornamentation, the other somewhat rounded, having radial lines and the inner edge along a spiral suture with a row of pits each with a distinct border. The periphery is extended into spinose projections similar to those seen in Chapman's species. Not enough specimens were obtained to make clear the full characters.

Genus **PATELLINA** Williamson, 1858**PATELLINA ADVENA** CushmanPlate 4, figures 10 *a-c*

*Patellina advena* CUSHMAN, U. S. Geol. Survey Prof. Paper 129-F, 1922, p. 135, pl. 31, fig. 9; Prof. Paper 133, 1923, p. 37; Publ. 342, Carnegie Inst. Washington, 1924, p. 32.

Test plano-convex, early portion composed of chambers spirally arranged, later ones elongate and becoming nearly annular; chambers partly divided by numerous longitudinal septae, visible from the exterior, forming what seems to be a radiating pattern; ventral side with numerous radiating lines near the periphery.

Diameter 0.30 mm., height 0.18 mm.

This small, scalelike species has been recorded from the region of Samoa and possibly is widely distributed in the South Pacific. The types are from the Lower Oligocene of the Coastal plain of the United States.

It is a species which has much finer divisions than the Atlantic species *P. corrugata* Williamson.

### Family CYMBALOPORETTIDAE

#### Genus TRETOMPHALUS Moebius, 1880

##### TRETOMPHALUS BULLOIDES (d'Orbigny)

##### Plate 5, figures 2-4

*Rotalina bulloides* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 104, pl. 3, figs. 2-5.

*Cymbalopora bulloides* CARPENTER, PARKER, and JONES, Introd. Foram, 1862, p. 216.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 638, pl. 102, figs. 7-12, text figs. 20 a-c.

*Tretomphalus bulloides* MOEBIUS, Beitr. Meeresfauna Insel Mauritius, 1880, p. 98, pl. 10, figs. 6-9.—CUSHMAN, Publ. 311, Carnegie Inst. Washington, 1922, p. 42, text figs 2, 3; Publ. 342, 1924, p. 36, pl. 11, figs. 1-3.

Test free, subglobular, early chambers rotaliform, numerous, rather coarsely perforate, forming a cap to which is attached a large final "balloon-chamber," subspherical, with coarse perforations on the ventral side and within, a "float-chamber" with a single opening at the base from which a tubular neck projects inward; color of the early chambers dark brown, the last chamber colorless.

Diameter 0.30 mm.; height 0.35 mm.

Figure 4 shows the adult, and figures 2 a-c the early stage somewhat similar to *Discorbis*.

### Family CASSIDULINIDAE

#### Genus CASSIDULINA d'Orbigny, 1826

##### CASSIDULINA CRASSA d'Orbigny

##### Plate 5, figures 5 a-c

*Cassidulina crassa* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 56, pl. 7, figs. 18-20.

There are a few specimens of this species which d'Orbigny described in his South American monograph.

### Family GLOBIGERINIDAE

#### Genus GLOBIGERINA d'Orbigny, 1826

##### GLOBIGERINA CONGLOMERATA Schwager

##### Plate 5, figures 6 a-c

*Globigerina conglomerata* SCHWAGER, Novara Exped., Geol. Theil., pt. 2, 1866, p. 255, pl. 7, fig. 113.—CUSHMAN, Bull. Scripps Inst. Oceanography, Tech. Ser., vol. 1, 1927, p. 172.



*Globigerina dutertrei* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 81, figs. 1-3 (not d'Orbigny).

*Globigerina dubia* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 79, figs. 17 a-c (not Egger).

Test subglobose in the early stages, consisting of but four chambers in each coil, closely grouped; aperture small and with a distinct lip; in later stages with five or six chambers in a coil, the last coil usually below the level of the others and with a distinct umbilicus.

This is one of the commonest species in the Pacific and was first described by Schwager from the Pliocene of Kar Nicobar.

GLOBIGERINA INFLATA d'Orbigny

Plate 5, figures 8 a-c

*Globigerina inflata* D'ORBIGNY, in Barker, Webb, and Berthelot, Hist. Nat. Îles Canaries, 1839, vol. 2, pt. 2 "Foraminifères," p. 134, pl. 2, figs. 7-9.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 601, pl. 79, figs. 8-10.

There are a few specimens of this species in the material, but not as common as the preceding.

GLOBIGERINA TRILOBA Reuss

Plate 6, figures 1 a-c

*Globigerina triloba* REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 374, pl. 47, fig. 11.

There are a very few specimens such as figured here in which the final coil is made up almost entirely by three chambers, and may be referred to Reuss's species.

GLOBIGERINA species

Plate 5, figures 7 a-c

This very small form is interesting as it has a smooth young, later becoming spinose and the umbilical area covered by a thin platelike projection of the ventral side of the last-formed chamber. Rhumbler has figured similar forms in his *Plankton Expedition Report*, and they occur in the Upper Cretaceous. Not enough specimens were obtained to warrant a full description as these are evidently young specimens.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

GLOBOROTALIA MENARDII (d'Orbigny)

Plate 6, figures 2 a-c

*Rotalia menardii* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 273; Modèles No. 10.

*Pulvinulina menardii* OWEN, Journ. Linn. Soc. London (Zool.), vol. 9, 1867, p. 148, pl. 5, fig. 6.

*Globorotalia menardii* CUSHMAN, Bull. Scripps Inst. Oceanography, Tech. Ser., vol. 1, 1927, p. 175.

This is a very widely distributed pelagic species, but shows some variation in the different oceans.

**GLOBOROTALIA TRUNCATULINOIDES (d'Orbigny)**

Plate 6, figures 3 a-c

*Rotalina truncatulinoides* D'ORBIGNY, in Barker, Webb, and Berthelot, Hist. Nat. Îles Canaries, vol. 2, pt. 2 "Foraminifères," 1839, p. 132, pl. 2, figs. 25-27.

*Pulvinulina truncatulinoides* PARKER and JONES, Phil. Trans., vol. 155, 1865; p. 398, pl. 16, figs. 41-43.

*Globorotalia truncatulinoides* CUSHMAN, Bull. Scripps Inst. Oceanography, Tech. Ser., vol. 1, 1927, p. 176.

The few specimens of this species are unusually spinose about the aperture.

**Family ANOMALINIDAE**

**Genus ANOMALINA d'Orbigny, 1826**

**ANOMALINA SCHMITTI, new species**

Plate 6, figures 5 a-c

Test with the dorsal side flattened, ventral side especially in the central portion forming a fairly high spire, last-formed coil evolute on both sides; periphery smooth, keeled, especially in the younger portion; eleven or twelve chambers in the last-formed coil in the adult, not inflated; sutures distinct, very slightly if at all depressed, limbate on the dorsal side, slightly curved; wall coarsely perforate, especially on the dorsal side; aperture low, broad at the peripheral margin.

Length 0.40 mm., breadth 0.36 mm., thickness 0.20 mm.

*Holotype*.—(Cat. No. 20781, U.S.N.M.) from Juan Fernandez, collected by Dr. Waldo Schmitt.

This is an interesting species, especially in the spire that is developed.

**ANOMALINA CORONATA H.B. Brady (?)**

Plate 6, figures 9 a-c

The peculiar form here figured is evidently an abnormal specimen. The chambers are not all arranged in a single plane, but in general it has the characters of this species.

**ANOMALINA (?) species**

Plate 6, figures 6 a-c

This peculiar specimen has some of the characters of *Anomalina*, yet in others, resembles *Nonion*. It is figured here for future reference.

## ANOMALINA cf. GROSSERUGOSA (Gümbel)

Plate 6, figures 7 a, b

The specimen figured may belong to this species, although there were not enough of them to give the full specific characters.

## Genus CIBICIDES Montfort, 1808

CIBICIDES species

Plate 6, figures 4, 8

These figures probably represent two distinct species. There is so much variation in these attached forms that it does not seem wise to give them specific names until a study may be made of a larger series to show developmental steps and variation, and especially the characters associated with microspheric and megalospheric forms.

## EXPLANATION OF PLATES

## PLATE 1

- FIGS. 1 a, b. *Gaudryina triangularis*.  $\times 100$ . a, front view; b, apertural view.  
 2 a-c. *Quinqueloculina punctulata*.  $\times 50$ . a, b, opposite sides; c, apertural view.  
 3 a-c. *Triloculina gracilis*.  $\times 95$ . a, b, opposite sides; c, apertural view.  
 4 a-c. *Quinqueloculina laevigata*.  $\times 150$ . a, b, opposite sides; c, apertural view.  
 5 a-d. *Quinqueloculina durandi*, new species. a, b, opposite sides; c, d, apertural views. a-c,  $\times 95$ ; d,  $\times 190$ .  
 6 a-c. *Triloculina subrotunda*.  $\times 50$ . a, b, opposite sides; c, apertural view.  
 7 a-c. *Quinqueloculina vulgaris*.  $\times 100$ . a, b, opposite sides; c, apertural view.

## PLATE 2

- FIGS. 1 a-c. *Triloculina crassa*.  $\times 50$ . a, b, opposite sides; c, apertural view.  
 2 a-c. *Triloculina rotunda*.  $\times 50$ . a, b, opposite sides; c, apertural view.  
 3. *Cornuspira involvens*.  $\times 65$ .  
 4 a-c. *Fischerina dubia*.  $\times 100$ . a, dorsal view; b, peripheral view; c, ventral view.  
 5 a, b. *Lenticulina convergens*.  $\times 95$ . a, side view; b, peripheral view.  
 6 a-c. *Carterina fulva*.  $\times 150$ . a, dorsal view; b, peripheral view; c, ventral view.

## PLATE 3

- FIGS. 1 a-c. *Marginulina* species.  $\times 150$ . a, side view; b, apertural view; c, front view.  
 2, 3. *Nodosaria substriatula*.  $\times 95$ . a, a, front views; b, b, apertural views.  
 4 a, b. *Lagena striata*.  $\times 95$ . a, front view; b, apertural view.  
 5 a, b. *Lagena laevigata*.  $\times 95$ . a, front view; b, apertural view.  
 6 a, b. *Lagena* species.  $\times 95$ . a, front view; b, apertural view.  
 7 a, b. *Sigmoidella (Sigmoidina) pacifica*.  $\times 95$ . a, front view; b, apertural view.  
 8 a, b. *Elphidium artienlatum*, variety *rugulosum*.  $\times 95$ . a, side view; b, peripheral view.  
 9 a-c. *Elphidium schmitti*, new species.  $\times 100$ . a, b, opposite sides; c, peripheral view.

- 10 *a, b. Elphidium* species.  $\times 65$ . *a*, side view; *b*, peripheral view.  
 11 *a, b. Bulimina patagonica*.  $\times 95$ . *a, b*, opposite sides.  
 12 *a, b. Buliminella elegantissima*.  $\times 95$ . *a, b*, opposite sides.

## PLATE 4

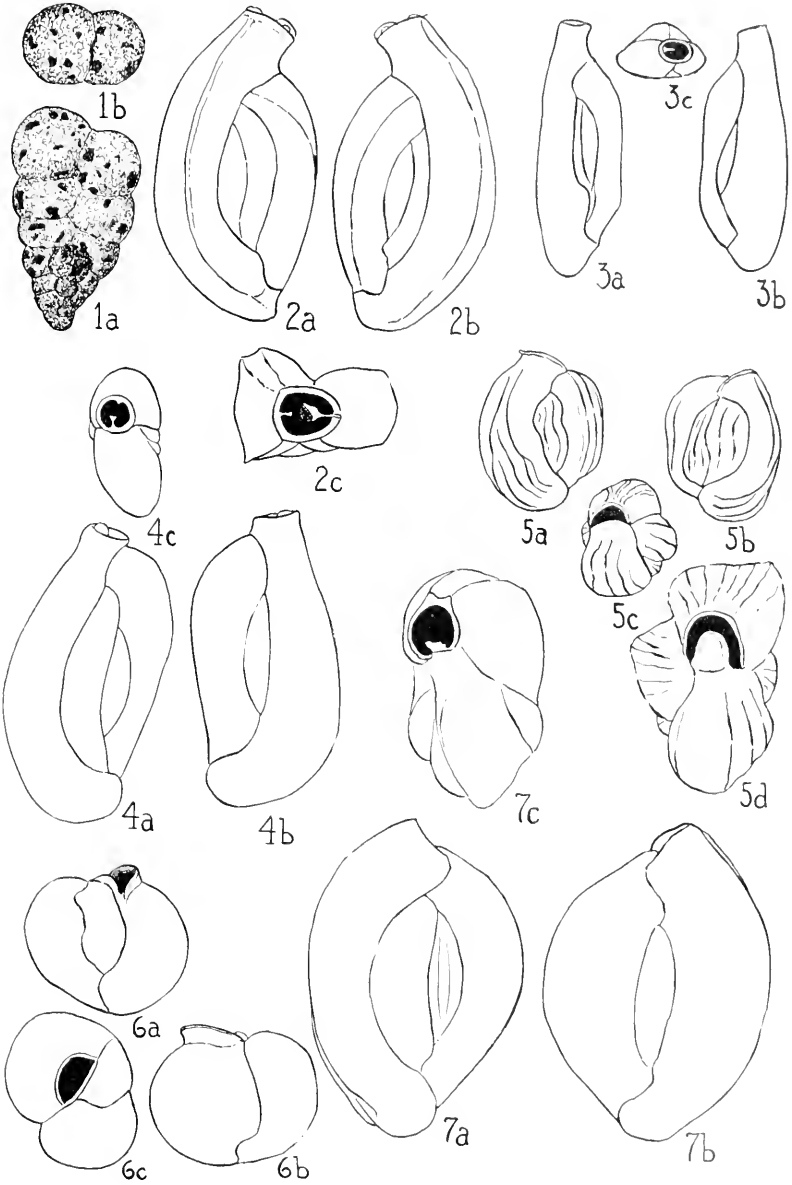
- FIGS. 1 *a-c. Bulimina patagonica*, variety *glabra*.  $\times 95$ . *a, b*, opposite sides; *c*, apertural view.  
 2 *a, b. Virgulina schreibersiana*.  $\times 95$ . *a, b*, opposite sides.  
 3 *a, b. Bolivina doniezi*, new species.  $\times 95$ . *a*, front view; *b*, apertural view.  
 4 *a, b. Bolivina subexcavata*, new species.  $\times 95$ . *a*, front view; *b*, apertural view.  
 5 *Bolivina* cf. *karreriana*, variety *carinata*.  $\times 95$ .  
 6 *a-c. Loxostomum* cf. *mayori*.  $\times 65$ . *a, b*, opposite sides; *c*, apertural view.  
 7 *a-d. Angulogerina carinata*.  $\times 95$ . *a-c*, views from different sides; *d*, apertural view.  
 8 *a-c. Urigerina virgalinoides*, new species.  $\times 150$ . *a, b*, opposite sides; *c*, apertural view.  
 9 *a, b. Spirillina vivipara*, variety.  $\times 150$ . *a, b*, opposite sides.  
 10 *a-c. Patellina advena*.  $\times 95$ . *a*, dorsal view; *b*, ventral view; *c*, side view.

## PLATE 5

- FIGS. 1 *a-c. Spirillina spinigera*, variety.  $\times 95$ . *a, c*, opposite sides; *b*, peripheral view.  
 2-4. *Tretomphalus bulloides*.  $\times 95$ . 2*a*, dorsal view; 2*b*, ventral view of young specimen. 3, peripheral view. 4*a*, dorsal view; 4*b*, side view of adult.  
 5 *a-c. Cassidulina crassa*.  $\times 95$ . *a, b*, opposite sides; *c*, peripheral view.  
 6 *a-c. Globigerina conglomerata*.  $\times 95$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.  
 7 *a-c. Globigerina* species.  $\times 150$ . *a*, ventral view; *b*, peripheral view; *c*, dorsal view.  
 8 *a-c. Globigerina inflata*.  $\times 50$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

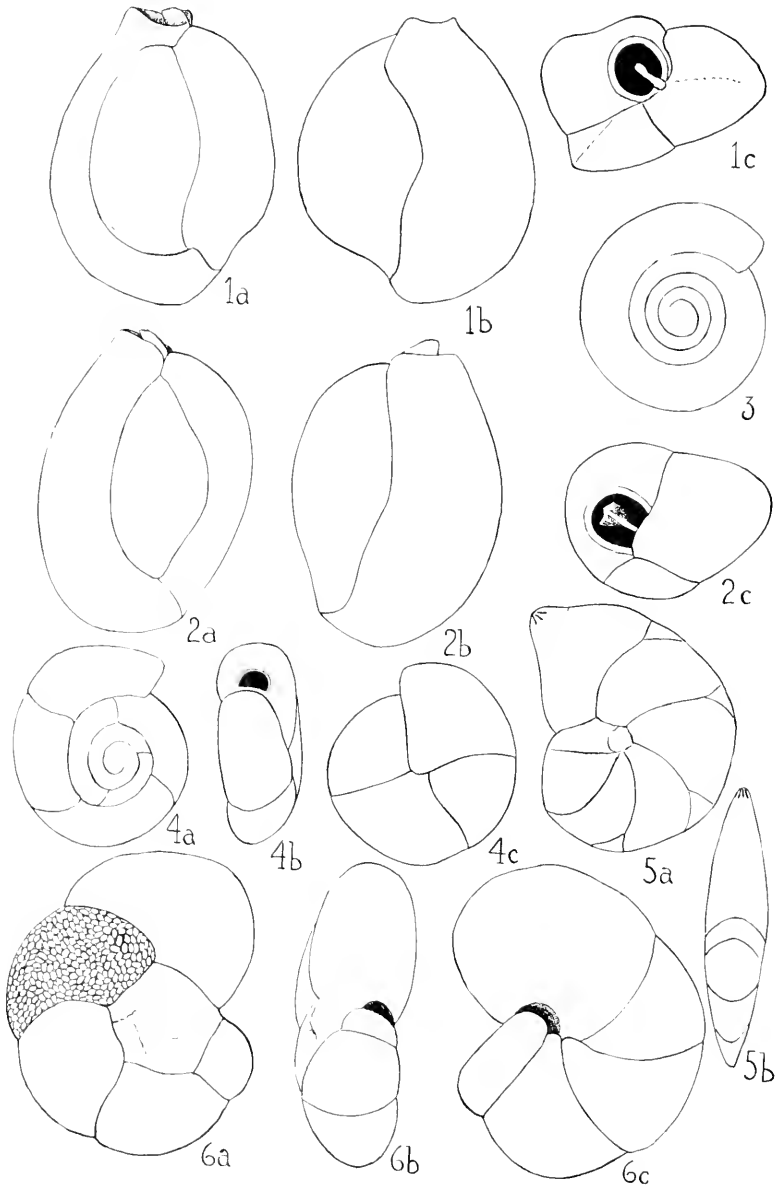
## PLATE 6

- FIGS. 1 *a-c. Globigerina triloba*.  $\times 50$ . *a*, peripheral view; *b*, dorsal view; *c*, ventral view.  
 2 *a-c. Globorotalia menardii*.  $\times 50$ . *a*, ventral view; *b*, peripheral view; *c*, dorsal view.  
 3 *a-c. Globorotalia truncatulinoides*.  $\times 65$ . *a*, ventral view; *b*, peripheral view; *c*, dorsal view.  
 4 *a-c. Cibicides* species.  $\times 45$ . *a*, peripheral view; *b*, ventral view; *c*, dorsal view.  
 5 *a-c. Anomalina schmitti*, new species.  $\times 95$ . *a*, ventral view; *b*, dorsal view; *c*, peripheral view.  
 6 *a-c. Anomalina* (?) species.  $\times 95$ . *a, c*, opposite sides; *b*, peripheral view.  
 7 *a, b. Anomalina* cf. *grosscrugosa*.  $\times 50$ . *a*, peripheral view; *b*, dorsal view.  
 8 *a-c. Cibicides* species.  $\times 45$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.  
 9 *a-c. Anomalina coronata*.  $\times 95$ . *a, b*, opposite sides; *c*, peripheral view.



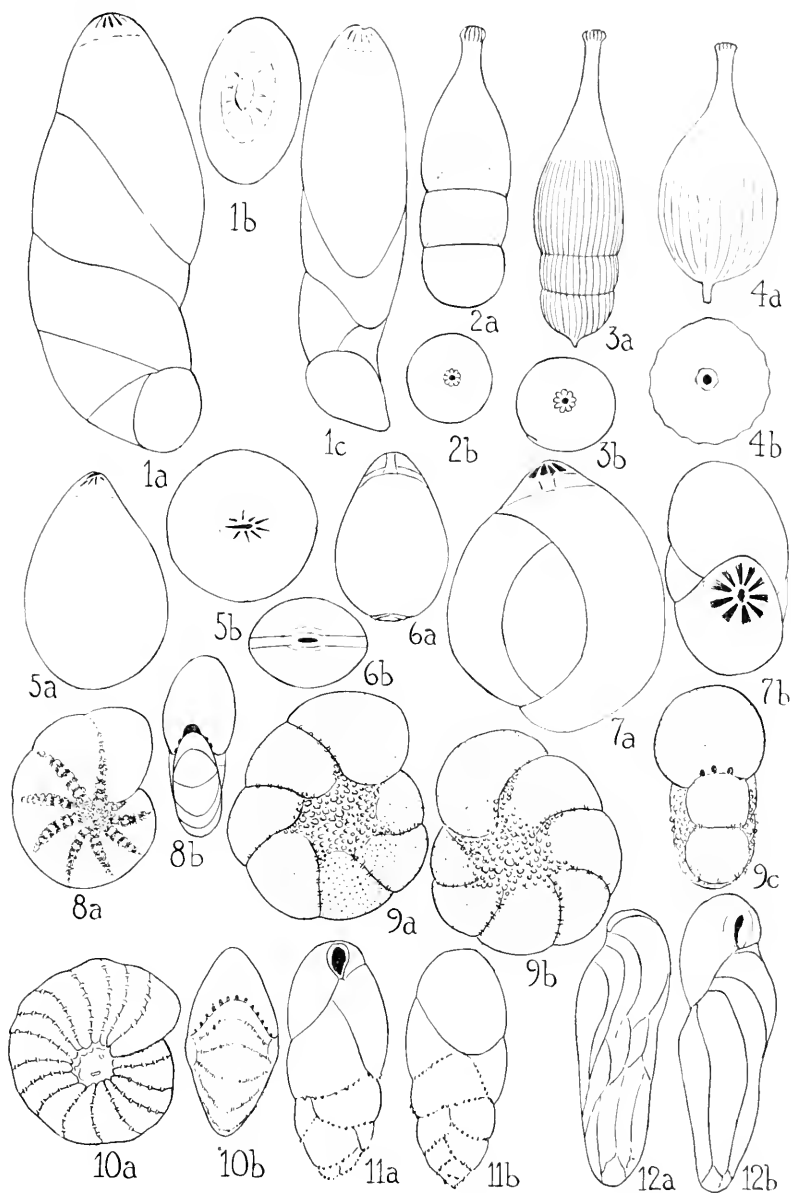
FORAMINIFERA FROM OFF JUAN FERNANDEZ ISLANDS

FOR EXPLANATION OF PLATE SEE PAGE 15



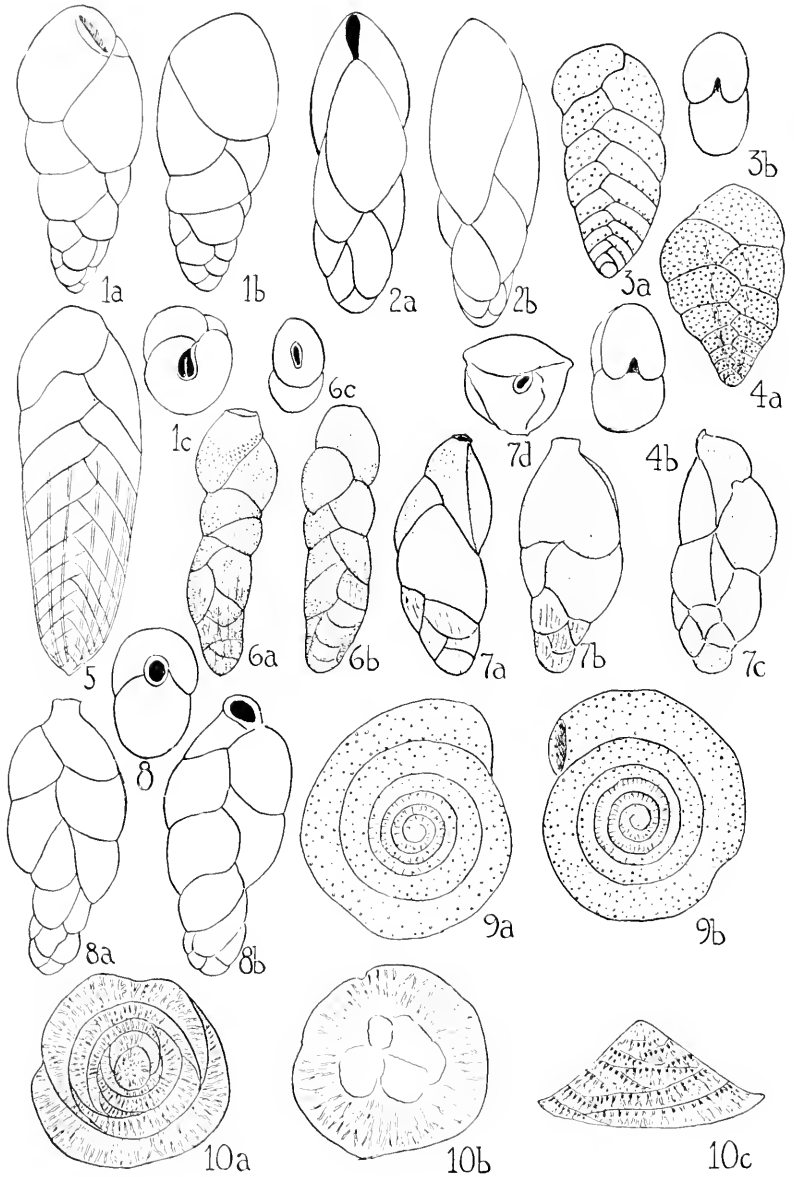
FORAMINIFERA FROM OFF JUAN FERNANDEZ ISLANDS

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FORAMINIFERA FROM OFF JUAN FERNANDEZ ISLANDS

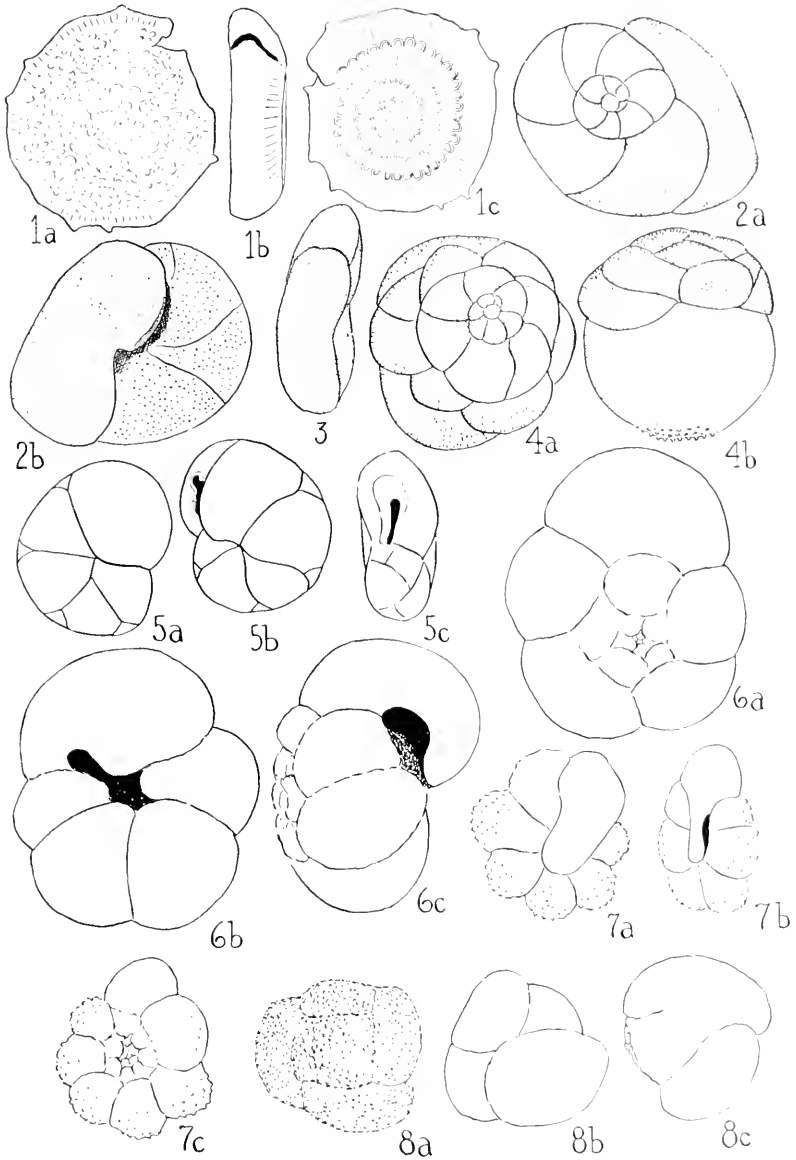
FOR EXPLANATION OF PLATE SEE PAGES 15 AND 16



FORAMINIFERA FROM OFF JUAN FERNANDEZ ISLANDS

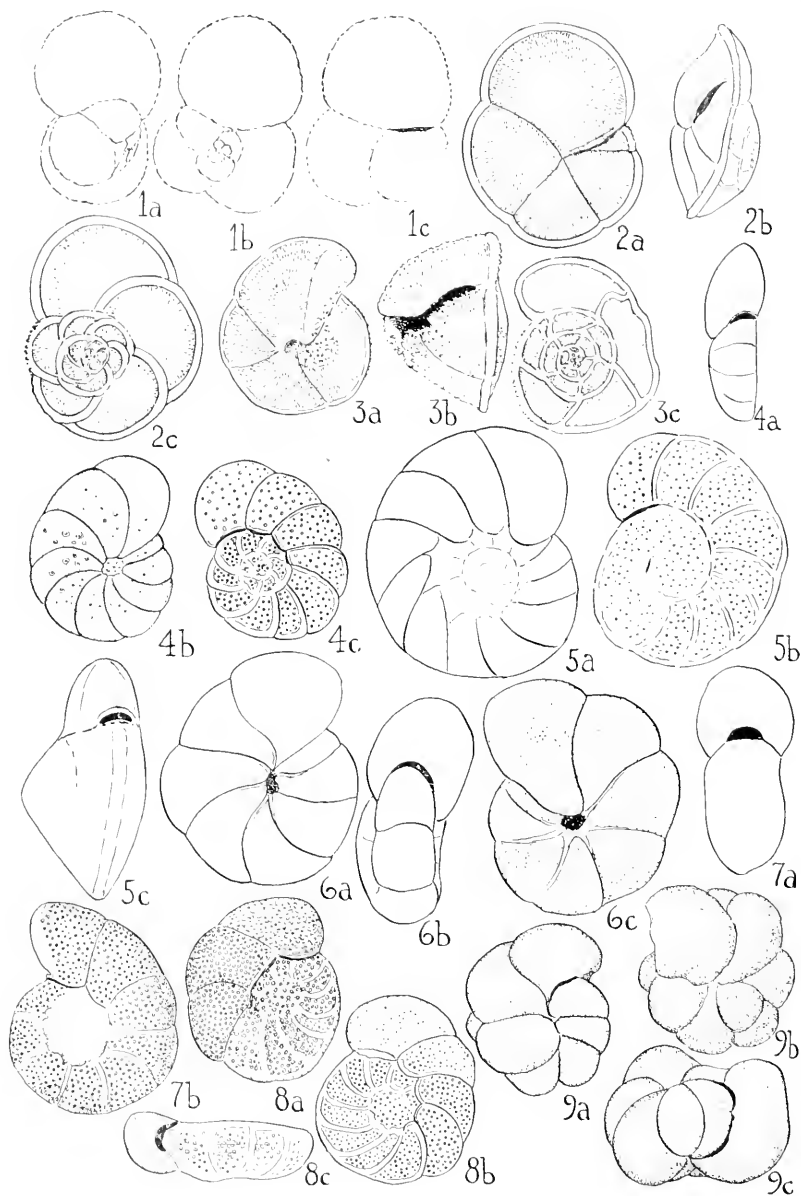
FOR EXPLANATION OF PLATE SEE PAGE 16





FORAMINIFERA FROM OFF JUAN FERNANDEZ ISLANDS

FOR EXPLANATION OF PLATE SEE PAGE 16



FORAMINIFERA FROM OFF JUAN FERNANDEZ ISLANDS

FOR EXPLANATION OF PLATE SEE PAGE 16



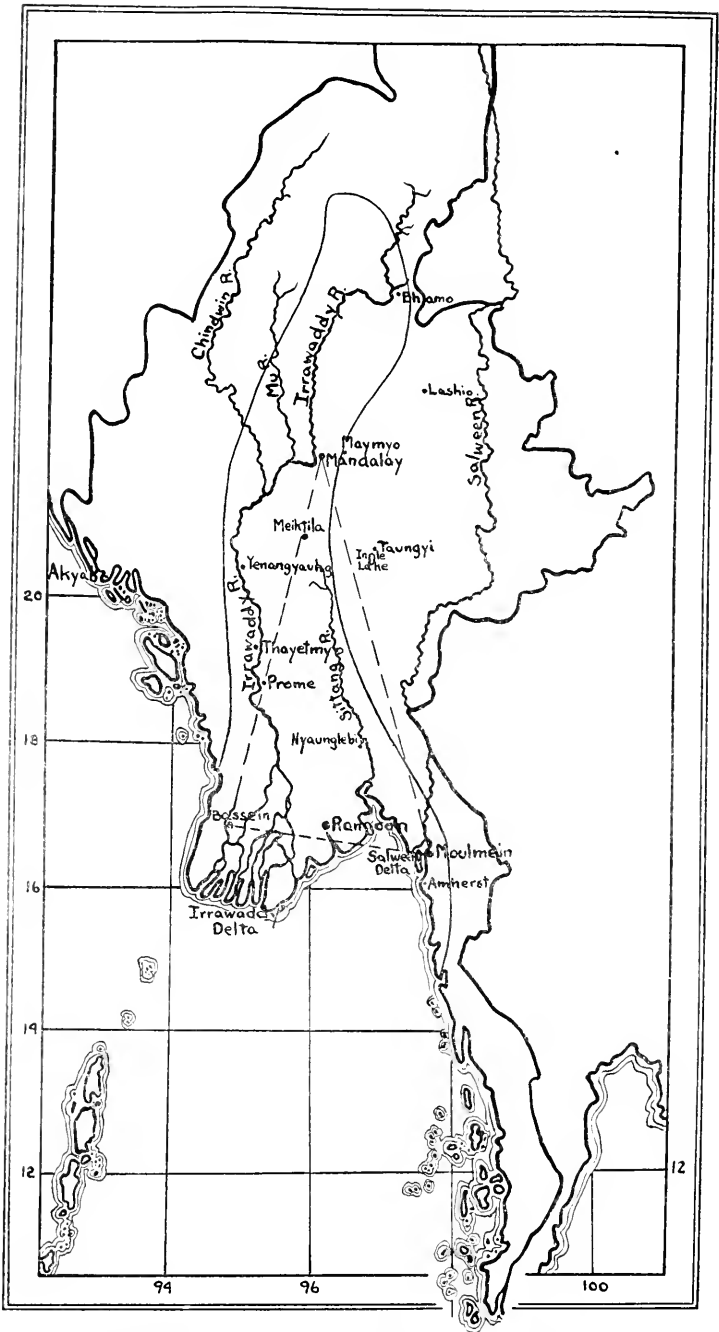


FIGURE 1.—SKETCH MAP OF BURMA WITH THE DIVISION BETWEEN THE SO-CALLED "PERIPHERAL HILL" AND "CENTRAL BASIN" REGION INDICATED BY THE FINE CONTINUOUS LINE; THE BROKEN LINE DELIMITING THE TRIANGULAR AREA REPRESENTS THE PORTION OF BURMA TO WHICH OUR KNOWLEDGE OF THE CONSTITUTION OF THE OLIGOCHAETE FAUNA IS ALMOST WHOLLY CONFINED. THE HEAVY OUTLINE BOUNDS THE PROVINCE EXCEPT ITS NORTHERN EXTREMITY

# A SUMMARY OF THE EARTHWORM FAUNA OF BURMA WITH DESCRIPTIONS OF FOURTEEN NEW SPECIES

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## INTRODUCTION

This paper is the first of a series which, it is hoped, will eventually present the results of an extensive as well as comprehensive survey of the terricolous oligochaete fauna of the province of Burma. There are numerous climatic, geographical, and for the time being, financial difficulties which prevent the orderly progress of such a survey. Further papers will necessarily appear, therefore, as circumstances permit, and for the immediate future at least, without reference to any methodical systematic or geographical sequence.

The writer wishes to thank for assistance given during the course of preparation of the present paper the United States National Museum, Harvard University, the United States Bureau of Fisheries, and the Marine Laboratories at Woods Hole; and Misses McNab and Carpenter for aid with illustrations

## GEOGRAPHICAL CONSIDERATIONS

The Province of Burma lies between  $8^{\circ}$  and  $28^{\circ} 30'$  north latitude, and between  $92^{\circ} 11'$  and  $101^{\circ} 91'$  east longitude. It includes an area of approximately 240,000 square miles. The extreme length is about 1,300 miles and the greatest width about 700 miles. The Province is said to be composed of seven natural regions: Two coastal strips, Arakan and Tenasserim; three hilly or mountainous regions, the western hills, the northern hills, and the Shan Plateau; and two central regions, the deltas and the dry zone. However, the country is commonly thought to comprise only two distinct regions which are called colloquially the "Plains" and the "Hills." (Fig. 1.)

The first-mentioned region may be designated the Central Basin region. This extends from the sea northward between the hills of the Burmese-Javan arc and the Indo-Malayan mountains to the

mountainous ranges reaching into Burma in a north and south direction from the Himalayas. This portion of the country consists of broad, undulating table-lands, rolling downs, and alluvial plains—including the deltas of the Irrawaddy and Sittang Rivers, and the valleys of the Chindwin, Mu, Sittang, and Irrawaddy Rivers. The delta of the Salween River may conveniently be included in this region. With the exception of the Pegu Yomas which separate the valleys of the Irrawaddy and Sittang Rivers, the land is less than a thousand feet above the level of the sea. Most of the cultivated land is within this region as well as a very large proportion of the population.

That portion of the country commonly called the "Hills" may be designated the Peripheral Hill region. This section of the country is largely over a thousand feet above sea level, with considerable areas above the 3,000-foot level, and walls off the central basin region from the rest of Asia. The mountains of the western limb of this peripheral region pass, with interruptions by the sea, through the Andaman and Nicobar Islands, Sumatra, Java, and New Guinea. Similarly the mountains of the eastern limb pass southward, through a small portion of Siam and the Malay Peninsula. On the western slopes of the Arakan and Tenasserim Hills are narrow coastal strips much broken up by the sea. There are numerous islands off both coasts, those west of Tenasserim constituting the Mergui Archipelago. The Peripheral Hill region is sparsely inhabited and covered with jungle of varying density except on the grassland plains of the Shan Plateau.

#### HISTORICAL CONSIDERATIONS

Our knowledge of the Oligochaete fauna of the Province of Burma has been based almost entirely on the study of museum specimens incidentally obtained by collectors who were primarily interested in other groups of animals. As might be expected, under these circumstances references in the literature to Burmese forms are rather scarce. The first significant contribution<sup>1</sup> was a series of three papers by Daniele Rosa in the Annals of the Civic Museum of Genoa, Italy,

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<sup>1</sup>Actually the first record of an earthworm from Burma is a description of *Perionyx m'intoshi* from Akyab published in 1883. The species was founded for a single immature worm. Some years later Beddard (1892) described more completely under the same specific name mature worms obtained from India, but indicated doubt as to the identity of the Burmese and Indian forms by prefixing, in the synonymy, the original reference with an interrogation mark. ("My observations upon *Perionyx m'intoshi* were made upon a single, not sexually mature, example; they were therefore not quite conclusive as to the distinctness of the species.") Michaelsen omitted Burma from the habitat of this species in his list of 1908. Stephenson, on the other hand, included *P. m'intoshi* in his list of Burmese forms. The specific identification of immature earthworms is notoriously difficult and is not usually attempted by systematists. In view of this difficulty and the distance between the Burmese and Indian habitats it hardly seems wise at the present time to attach any particular importance to Beddard's record.

in which the following were either described or recorded from Burma for the first time:

| 1888                                | Now                                  | Type locality |
|-------------------------------------|--------------------------------------|---------------|
| <i>Perichaeta feae</i> -----        | <i>Pheretima feae</i> -----          | Kawkareik.    |
| <i>Perichaeta birmanica</i> -----   | <i>Pheretima birmanica</i> -----     | Bhamo.        |
| <i>Megascolex armatus</i> -----     | <i>Megascolex mauritii</i> -----     | Mandalay.     |
| <i>Perionyx excavatus</i> -----     | -----                                | Bhamo.        |
| 1890a                               |                                      |               |
| <i>Desmogaster doriae</i> -----     | -----                                | Meteleo.      |
| <i>Moniligaster beddardii</i> ----- | <i>Drawida barwelli</i> -----        | Chiala.       |
| <i>Bilimba papillata</i> -----      | <i>Glyphidrilus papillatus</i> ----- | Cobapo.       |
| <i>Typhaeus laevis</i> -----        | <i>Eutyphoeus levis</i> -----        | Cobapo.       |
| <i>Typhaeus foveatus</i> -----      | <i>Eutyphoeus foveatus</i> -----     | Rangoon.      |
| 1890b                               |                                      |               |
| <i>Perichaeta carinensis</i> -----  | <i>Pheretima carinensis</i> -----    | Meteleo.      |
| <i>Perichaeta bournei</i> -----     | <i>Pheretima bournei</i> -----       | Cobapo.       |
| <i>Perichaeta peguana</i> -----     | <i>Pheretima peguana</i> -----       | Rangoon.      |
| <i>Perichaeta campanulata</i> ----- | <i>Pheretima campanulata</i> -----   | Palon.        |
| <i>Perionyx arboricola</i> -----    | -----                                | Cobapo.       |

These worms had been secured by Signor Leonardo Fea in the course of four years collecting in a region extending from Moulmein to Bhamo.

Smaller collections of earthworms made by friends and officers of the Indian Museum at Calcutta have been studied by Michaelsen and by Stephenson. Three new species were described by Michaelsen in 1907:

|                                  |                    |
|----------------------------------|--------------------|
| <i>Eupolygaster browni</i> ----- | Lashio.            |
| <i>Woodwardia bunkilli</i> ----- | Buthidaung, Akyab. |
| <i>Pheretima andersoni</i> ----- | Amherst.           |

In an elaboration of the 1907 paper Michaelsen (1908) added:

|                                     |          |
|-------------------------------------|----------|
| <i>Pheretima heterochaeta</i> ----- | Manchio. |
|-------------------------------------|----------|

In this paper Burma is included in the habitat of *Pheretima houletii*, the writer considering Rosa's *P. campanulata* to be a synonym of *P. houletii*. Stephenson in 1923 followed Michaelsen in this respect. It has since been shown (Gates 1927a) that Rosa's species is valid.

Stephenson, in three papers in the Records of the Indian Museum, recorded three further species from the Province:

|  |                      |
|--|----------------------|
| 1912. <i>Pheretima posthuma</i> -----  | Yenangyaung, etc.    |
| 1916. <i>Pheretima lignicola</i> ----- | Thinganyinaung, etc. |
| 1918. <i>Perionyx fulvus</i> -----     | Inle Lake.           |

In 1923 Stephenson listed 37 species of earthworms from Burma. The area designated by this name included, however, in addition to Burma proper, the Andaman and Nicobar Islands, as well as Rangamati, a district which is part of the Province of Bengal. Seventeen of the worms so listed had been found in only one of these three

extra-provincial areas. *P. houletti* and *P. m'intoshi* were included and *P. campanulata*, *P. posthuma*, and *E. levis*<sup>2</sup> were omitted.

Later Stephenson (1924) described two more species:

|                                  |           |
|----------------------------------|-----------|
| <i>Drawida fluviatilis</i> ..... | Yaungwhe. |
| <i>Ramiella parva</i> .....      | Yaungwhe. |

In a recent series of papers Gates (1925-1927) has added the following:

|                                      |              |
|--------------------------------------|--------------|
| <i>Drawida caerulea</i> .....        | Nyaunglebin. |
| <i>Drawida gracilis</i> .....        | Rangoon.     |
| <i>Drawida longatria</i> .....       | Rangoon.     |
| <i>Drawida peguana</i> .....         | Rangoon.     |
| <i>Drawida rangoonensis</i> .....    | Rangoon.     |
| <i>Drawida rara</i> .....            | Rangoon.     |
| <i>Drawida tecta</i> .....           | Yaungwhe.    |
| <i>Pontodrilus bermudensis</i> ..... | Kadonkani.   |
| <i>Notoscolex birmanicus</i> .....   | Maymyo.      |
| <i>Pheretima anomala</i> .....       | Rangoon.     |
| <i>Pheretima elongata</i> .....      | Rangoon.     |
| <i>Pheretima hawayana</i> .....      | Taungyi.     |
| <i>Pheretima houletti</i> .....      | Rangoon.     |
| <i>Pheretima insolita</i> .....      | Rangoon.     |
| <i>Pheretima planata</i> .....       | Rangoon.     |
| <i>Octochaetus birmanicus</i> .....  | Rangoon.     |
| <i>Eutyphoeus peguanus</i> .....     | Rangoon.     |
| <i>Eutyphoeus rarus</i> .....        | Rangoon.     |
| <i>Eutyphoeus spinulosus</i> .....   | Bassein.     |
| <i>Pontoscolex corethrurus</i> ..... | Rangoon.     |

In an appendix to a short paper on a species of *Notoscolex* Gates (1927b) listed 42 worms from the Province. This included *P. m'intoshi* but not *P. campanulata*. The paper had been written early in 1926, but owing to a series of mischances had not been published until after the appearance of the paper in which *P. campanulata* was restored to specific status.

The present paper contains descriptions of 14 new species listed below, and notes on two known species:

|                                     |            |
|-------------------------------------|------------|
| <i>Drawida constricta</i> .....     | Mandalay.  |
| <i>Drawida flexa</i> .....          | Kawkareik. |
| <i>Drawida tumida</i> .....         | Moulmein.  |
| <i>Notoscolex depressus</i> .....   | Maymyo.    |
| <i>Notoscolex lunatus</i> .....     | Maymyo.    |
| <i>Pheretima minuta</i> .....       | Lashio.    |
| <i>Pheretima ornata</i> .....       | Lashio.    |
| <i>Octochaetus lunatus</i> .....    | Mandalay.  |
| <i>Eutyphoeus bifovis</i> .....     | Mandalay.  |
| <i>Eutyphoeus constrictus</i> ..... | Meiktila.  |
| <i>Eutyphoeus excavatus</i> .....   | Meiktila.  |
| <i>Eutyphoeus hastatus</i> .....    | Prome.     |
| <i>Eutyphoeus planatus</i> .....    | Prome.     |
| <i>Eutyphoeus similis</i> .....     | Kawkareik. |

<sup>2</sup> This species was founded for a single specimen which was so poorly preserved that only the external characters were described. The absence of genital markings indicates that the worm was also immature. The species must therefore be considered invalid.



At the present time that portion of the oligochaete fauna of the Province which is known comprises 56 valid species distributed among five subfamilies as follows (peregrine species starred):

## MONILIGASTRINAE

|                             |  |                          |
|-----------------------------|--|--------------------------|
| <i>Desmogaster doriae.</i>  |  | <i>Drawida gracilis.</i> |
| <i>Eupolygaster browni.</i> |  | <i>longatria.</i>        |
| <i>Drawida barwelli.*</i>   |  | <i>peguana.</i>          |
| <i>caerulea.</i>            |  | <i>rangoonensis.</i>     |
| <i>constricta.</i>          |  | <i>rara.</i>             |
| <i>flexa.</i>               |  | <i>tecta.</i>            |
| <i>fluviatilis.</i>         |  | <i>tumida.</i>           |

## MEGASCOLECINAE

|                                  |  |                             |
|----------------------------------|--|-----------------------------|
| <i>Pontodrilus bermudensis.*</i> |  | <i>Pheretima hawayana.*</i> |
| <i>Woodwardia burkilli.</i>      |  | <i>heterochaeta.*</i>       |
| <i>Notoscolex birmanicus.</i>    |  | <i>houletti.*</i>           |
| <i>depressus.</i>                |  | <i>insolita.</i>            |
| <i>lunatus.</i>                  |  | <i>lignicola.*</i>          |
| <i>Megascolex mauritii.*</i>     |  | <i>minuta.</i>              |
| <i>Pheretima anomala.</i>        |  | <i>ornata.</i>              |
| <i>andersoni.</i>                |  | <i>peguana.*</i>            |
| <i>birmanica.</i>                |  | <i>planata.*</i>            |
| <i>bournei.</i>                  |  | <i>posthuma.*</i>           |
| <i>complanulata.*</i>            |  | <i>Perionyx arboricola.</i> |
| <i>carinensis.</i>               |  | <i>excavatus.*</i>          |
| <i>elongata.*</i>                |  | <i>fulvus.*</i>             |
| <i>feae.</i>                     |  |                             |

## OCTOCHAETINAE

|                                |  |                             |
|--------------------------------|--|-----------------------------|
| <i>Octochaetus birmanicus.</i> |  | <i>Eutyphoeus planatus.</i> |
| <i>lunatus.</i>                |  | <i>peguanus.</i>            |
| <i>Eutyphoeus bifovis.</i>     |  | <i>rarus.</i>               |
| <i>constrictus.</i>            |  | <i>similis.</i>             |
| <i>excavatus.</i>              |  | <i>spinulosus.</i>          |
| <i>foveatus.</i>               |  | <i>Ramiella parva.</i>      |
| <i>hastatus.</i>               |  |                             |

## GLOSSOSCOLECINAE

*Pontoscolex corethrurus.\**

## MICROCHAETINAE

*Glyphidrilus papillatus.\**

## ZOÖGEOGRAPHICAL CONSIDERATIONS

## LOCAL DISTRIBUTION

If a line be drawn on a map of Burma from Moulmein west to Bassein, thence north to Mandalay, and then south to Moulmein, a triangular area in the southern half of the central basin region will be marked off. The relatively small and possibly least interesting portion of the Province thus delimited contains practically all of the localities where anything has been done in the way of collecting

earthworms. Very little is known about the worms of regions lying outside of this triangle. Only one endemic form is known from the district south of Moulmein, one from that portion of the central region north of Mandalay, and one from the Akyab district on the western border of the Province, while all records of occurrence in the "Hills" are of four localities, not widely separated, in the Shan Plateau (mideastern section of the Peripheral Hill region). Practically all of the hill country to the west, north, and far south, the two coastal strips, as well as the middle and northern portions of the central basin region are yet to be investigated. Within the triangle there are many important areas which have not yet been studied, and only the district immediately around the town of Rangoon can be considered adequately explored.

Furthermore a considerable proportion of the earthworm fauna of any locality can be obtained only during the rainy season (Gates, 1926c). Most collecting has been done hitherto, except in Rangoon and the immediate vicinity, only toward the end of the rainy season or in the dry season months. It is therefore at least possible, if not probable, that numerous species are yet to be found, even in those localities where extensive collections have already been made.

In view of these circumstances it is not feasible at the present moment to attempt an extensive discussion of the distribution of the local forms. It may be of interest, however, to point out briefly, certain "tendencies" in the accumulating knowledge of the earthworms of the Province.

Most important of these tendencies is the apparent restriction of worms to one or the other of the two major regions. (The peregrine species are marked with an asterisk in the list on p. 5.) The endemic species belong to 10 genera, 6 of which (with 8 species)—

|                     |  |                   |
|---------------------|--|-------------------|
| <i>Desmogaster</i>  |  | <i>Notoscolex</i> |
| <i>Eupolygaster</i> |  | <i>Perionyx</i>   |
| <i>Woodwardia</i>   |  | <i>Ramiella</i>   |

have been collected only in the Peripheral Hill region. Two genera (with 12 species)—

|                    |  |                   |
|--------------------|--|-------------------|
| <i>Octochaetus</i> |  | <i>Eutyphoeus</i> |
|--------------------|--|-------------------|

have been found only in the plains of the central basin region. Although the two remaining genera have been taken in both the "Hills" and "Plains," only three forms—

|                          |  |                           |
|--------------------------|--|---------------------------|
| <i>Drawida longatria</i> |  | <i>Pheretima insolita</i> |
| <i>Pheretima anomala</i> |  |                           |

have been found in both regions, whereas eight species of *Drawida* appear to be confined to the "Plains" and two to the "Hills." Similarly four of the nine endemic *Pheretima* seem to be restricted

to the "Hills" and three to the "Plains." Even some of the peregrine species appear to be similarly limited to one or the other of the two major regions of the Province. Four species—

|                            |  |                                |
|----------------------------|--|--------------------------------|
| <i>Megascolex mauritii</i> |  | <i>Pheretima planata</i>       |
| <i>Pheretima peguana</i>   |  | <i>Pontoscolex corethrurus</i> |

have been collected only in the "Plains," while two other species

|                           |  |                               |
|---------------------------|--|-------------------------------|
| <i>Pheretima hawayana</i> |  | <i>Pheretima heterochaeta</i> |
|---------------------------|--|-------------------------------|

have been taken only in the Shan Plateau.

Other tendencies may be mentioned more briefly. Every new collection brings to light new species, usually belonging to two important genera, *Drawida* and *Eutyphoeus*. Even when the collections are made at places only comparatively short distances away from regions already studied, new forms are found. Thus, at places as near to each other as Rangoon and Bassein or Mandalay and Meiktila distinctly different species of *Eutyphoeus* occur. It hardly seems possible to move 200 miles in any direction from any locality without entering regions containing at least several new species. In contrast to this multiplicity of species only three significant genera have been added to the local fauna in the last 17 years and all three belong to families previously known to occur in the Province.

#### EXTRA PROVINCIAL DISTRIBUTION

Two subfamilies, the Glossoscolecinae and the Microchaetinae, and four genera—

|                    |  |                     |
|--------------------|--|---------------------|
| <i>Pontodrilus</i> |  | <i>Pontoscolex</i>  |
| <i>Megascolex</i>  |  | <i>Glyphidrilus</i> |

are represented in the Burmese region only by peregrine species. Two subfamilies, the Moniligastrinae and the Megascolecinae, and three genera—

|                  |  |                 |
|------------------|--|-----------------|
| <i>Drawida</i>   |  | <i>Perionyx</i> |
| <i>Pheretima</i> |  |                 |

are represented in the local fauna by both endemic and peregrine species. The remaining family, the Octochaetinae, and seven genera—

|                     |  |                    |
|---------------------|--|--------------------|
| <i>Desmogaster</i>  |  | <i>Octochaetus</i> |
| <i>Eupolygaster</i> |  | <i>Eutyphoeus</i>  |
| <i>Woodwardia</i>   |  | <i>Ramiella</i>    |
| <i>Notoscolex</i>   |  |                    |

are represented in this Province only by endemic species. None of the indigenous forms belong to genera restricted to this Province. Burma is thus related zoogeographically to certain other regions, as follows: *Desmogaster* and *Eupolygaster* have been found in Sumatra and Borneo; *Drawida* occurs in South India and Ceylon, the eastern

Himalayas, Bengal, Central India, and possibly Borneo; *Woodwardia* has been taken in South India and Ceylon, Australia, and Java; *Notoscolex* in South India and Ceylon, the eastern Himalayas, Australia, and New Zealand; *Pheretima* in southeastern and eastern Asia; *Perionyx* in India, Australia, Sumatra, and Java; *Octochaetus* has been found elsewhere only in New Zealand and India (all of the Indian and Burmese species belong to the distinct subgenus *Octochaetoides*); *Ramiella* and *Eutyphoeus* have been collected only in India.

Interesting theories have been put forward to explain these relationships. Discussion of these theories so far as Burma may be concerned is unprofitable at present and will be reserved for some future paper.

#### SUMMARY

1. The number of endemic species common to both the central basin region and the Peripheral Hill region is small. Less than half of the peregrine species may be said to occur in both regions.

2. The Moniligastrinae with the exception of *Drawida* are confined to the "Hills." One species of *Drawida* has been found in both "Hills" and "Plains."

3. The Octochaetinae except *Ramiella* are restricted to the central and southern portions of the central region. *Ramiella* is limited to the "Hills."

4. In the large subfamily Megascolecinae, *Woodwardia*, *Notoscolex*, and *Perionyx* (except two peregrine species) are confined to the peripheral region, while *Pheretima* is present in both sections.

5. The dominant genus in the central plains seems to be *Eutyphoeus*, in the "Hills" possibly *Notoscolex*.

6. The endemic species belong to genera which occur outside of Burma in one or more of the following areas: Sumatra, Java, and Borneo; South India and Ceylon; Australia and New Zealand; the Malay Archipelago; the eastern Himalayas, including Abor and Assam.

#### SYSTEMATIC CONSIDERATIONS<sup>2</sup>

##### *DRAWIDA CONSTRICTA*, new species

*Description of the type-specimen, external characteristics* (Cat. No. 19251, U.S.N.M.).—Length, 73 mm. Diameter, 3-3½ mm. Number of segments, 148. Color: Grayish, except on the clitellum where the segments are deep red.

The prostomium is prolobous.

<sup>2</sup>It should be pointed out that the collections on which this portion of the paper is based were made for the writer by various individuals, none of whom have had biological or other scientific training. In some instances the collecting was done in quite unfavorable months. This will explain the necessity for certain remarks hereafter.

Segments vii to xiii have a secondary furrow posterior to the setae of the segment. Segments x to xiii have a second furrow anterior to the setae of the segment. Most of the segments posterior to the clitellar region have two slight secondary furrows to each segment, one anterior to and one posterior to the setae of the segment.

There are pore like depressions in the intersegmental furrows from 4/5 posteriorly, but apparently no functional dorsal pores.

The setae begin on ii, and are closely paired; *ab* is equal to *cd*, *aa* is less than *bc*, and *dd* is about one-half of the circumference.

The clitellum is on x-xiii (4).

The male pores are on the conical papillae on 10/11, and are slightly external to *b*.

The female pores are in 11/12 and are in line with *b*.

The spermathecal pores are in 7/8 in the region of *cd*.

The most conspicuous genital marking is the conical papilla on each side of the worm in the furrow 10/11. The inner edge of the papilla is internal to *b*. The papillae are bent slightly toward each other and are constricted slightly at the base by a circumferential furrow and bear at the tip the male pores. Posterior to the setae of x and extending to *c* on each side is a transversely elongate depression, slightly deeper at each end than in the middle. On each side of xi, posterior to the setae, and in line with the male porophore is a slight depression. On segment xii, behind the setae, and extending slightly beyond *b* on each side is an oval, concave, glandular like area, sharply delimited by a circumferential furrow.

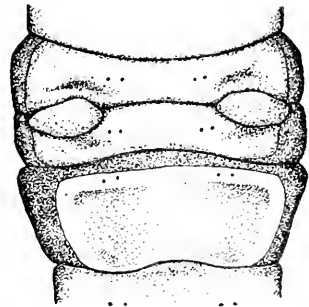


FIGURE 2.—DRAWIDA CONSTRICTA.  
EXTERNAL VIEW OF VENTRAL GENITAL REGION

*Internal anatomy.*—Septa 5/6, 6/7, 7/8, and 8/9 are thickened.

There are two gizzards in segments xvi and xvii. The wall of the alimentary canal is slightly thickened in xv.

The last pair of hearts is in ix.

The testis sacs are ovoid bodies in ix and x, half in each segment. The vas deferens is a small coiled mass on the posterior surface of 9/10, under each testis sac, and passes into the middle of the prostate. The prostates are small dome-shaped bodies on the parietes. The surface is coarsely granulated.

The ovarian chamber is closed dorsally just over the alimentary canal. The ovisacs extend into xv. The spermathecal ampulla is large and ovoid on the posterior face of 7/8. The duct is fine and is coiled into several loops.

*Distribution.*—Mandalay, Prome, Thayetmyo.

*Remarks.*—The clitellum is usually on x-xiii, but occasionally extends onto ix and xiv. The male porophores appear to be characteristic but the other genital markings vary considerably, as in other species of this genus. Many of the Mandalay worms have a small whitish depression on each side on segments x and xi in line with the male porophore. Occasionally the two depressions of x are confluent at the center to form a single elongate depression. In some of the specimens glandular areas are present in the region of the depressions or the depression may be lacking and the glandular areas slightly elevated. Oval, smooth-surfaced, concave areas similar to the one on xii in the type-specimen may occur on ix, xi, xii, or xiii. In specimens collected at Prome and Thayetmyo the unpaired markings on ix and xii are slightly different in appearance, extending through all of region *cc* on the posterior portion of the segment which is enlarged to 4-6 times the width of the segment anterior to the setae. Occasionally the setae are included in the anterior border of the marking. The outer ends of these markings are more bluntly rounded than those on the Mandalay specimens.

The two gizzards are in segment xv and xvi or xvi and xvii.

The prostates are sessile and project into the body cavity only very slightly.

This worm is very similar to *D. rara*, with which it may eventually have to be included. It is to be distinguished from the latter species chiefly by the appearance of the male porophores, the position and character of the genital markings, and the smaller number of gizzards.

#### DRAWIDA FLEXA, new species

*Description of the type-specimen, external characteristics* (Cat. No 19252, U.S.N.M.).—Length, 104 mm. Diameter,  $3\frac{1}{2}$ -5 mm. Number of segments, 238. Color: Grayish white, except on the clitellum where the segments are reddish.

The prostomium is prolobous.

Segment vii has a deep secondary furrow posterior to the setae. Segments viii, ix, etc., posteriorly, have two secondary furrows per segment, one anterior to and one posterior to the setae of the segment.

Dorsal pores are lacking.

The setae begin on segment ii and are closely paired; *ab* is equal to *cd*, *aa* is greater than *bc*, *dd* is slightly greater than one-half of the circumference.

The clitellum is on x-xiii.

The male pores are on 10/11, in *bc*, slightly nearer *b* than *c*, and are surrounded by slight, whitish, glandular elevations on x and xi.

The female apertures are in 11/12, just external to *b*.

The spermathecal pores are in 7/8, just internal to *c*.

The genital markings are small, nearly round, whitish elevations with a grayish spot at the center. They are located on segments vii, x, xi, and xii. Those on vii lie in contact with 7/8 in line with *cd*, on each side. The papillae on x are in *bc* about equidistant from *b* and *c*, and are in line with the eight setae of the segment. The markings on xii are in *bc*, in line with the papillae of x but are on the anterior border of the segment in contact with 11/12. There is a single median papilla in *aa* on xi, in contact anteriorly with 10/11.

*Internal anatomy.*—Septa 5/6, 6/7, 7/8, and 8/9 are thickened.

The four gizzards are in segments xix, xx, xxi, and xxii.

The last pair of hearts is in segment ix.

The large testis sacs are in ix and x, constricted by 9/10. The vas deferens is coiled into a small mass on the posterior face of 10/11, under the testis sac of each side. The prostate is bent into a horseshoe shape, with the opening toward the nerve cord and the posterior limb passing into the parietes. The vas deferens passes into the end of the anterior limb.

Segment xi is reduced to a small closed chamber. The ovisacs extend into xv. The spermathecal ampulla is large and ovoid. The duct

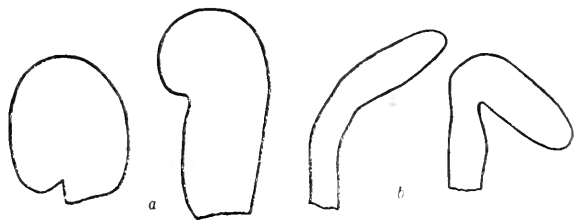


FIGURE 3.—DRAWIDA FLEXA. a. PROSTATES  $\times$  ABOUT 14. b. ATRIA  $\times$  ABOUT 14

is coiled into a small mass on the posterior face of 7/8 immediately under the ampulla, and is looped as it passes from the ampulla along the septum to the parietes. The atrium in vii is finger shaped and stands erect in the segment.

*Distribution.*—Kyundo, Kawkareik (October).

*Remarks.*—The length varies from 80–110 mm., and the diameter from  $3\frac{1}{2}$ –4 mm. at the posterior end to  $4\frac{1}{2}$ – $5\frac{1}{2}$  mm. at the anterior end.

The male pores of most of the specimens are at the tops of slight conical elevations on 10/11. The spermathecal pores are in line with *c* or *d*, just internal to *c* or just external to *d*.

The four gizzards are in xviii–xxi, xix–xxii, or xx–xxiii.

The prostates are coiled or bent into various positions.

The small round genital papillae occur on segments vii–xii. They are paired in *bc* on the anterior or posterior borders of the segments. Unpaired median papillae occur in *aa* on the anterior, middle, or posterior thirds of segments vii, ix, x, and xi.

The atria are often bent at various angles.

## DRAWIDA LONGATRIA Gates 1925

*Drawida longatria* GATES, Ann. Mag. Nat. Hist., ser. 9, vol. 16, p. 50, 1925.

*Distribution.*--Mandalay, Thazi.

*Remarks.*—In a collection from Mandalay are two forms which appear superficially to be different from each other as well as from *D. longatria*. The spermathecal atrium, the vas deferens, and the prostates are, however, characteristic of *D. longatria*.

In specimens of the first form definitely marked genital papillae are lacking; the male porophores are bluntly rounded projections in 10/11; the testis sacs lie in both x and xi; the gizzards are two or three in xv-xvii; the atria are short, 20-30 mm. long, with large loosely coiled loops and with the free end very slightly enlarged.

In specimens of the second form genital papillae are also lacking; the male porophores are slightly elevated, flat-surfaced, oval areas extending across 10/11, about three-fourths of the papilla on segment x, the portion of the papilla on x surrounded by a narrow strip of whitish tissue; the male pore a crescentic groove, with the horns of the crescent directed forward, the pore located on the posterior part of the papilla; two or three gizzards in xv-xviii.

## DRAWIDA TUMIDA, new species

*Description of the type-specimen, external characteristics* (Cat. No. 19253, U.S.N.M.).—Length, 100 mm. Diameter, 4 mm. Number of segments 197. Color: Grayish, except on the clitellum where the segments are deep red.

The prostomium is prolobous.

Segments vii-xx, inclusive, have two secondary furrows per segment, one anterior to and the other posterior to the setae of the segment. Slighter tertiary furrows are present on x and xi.

Functional dorsal pores are lacking.

The setae begin on segment two and are closely paired; *ab* is equal to *cd*, *aa* is less than *bc*, and *dd* is greater than one-half of the circumference.

The clitellum is on x-xiii (4).

The male pores are in 10/11, in *bc*, nearer *b* than *c*, on the tops of roughly conical papillae.

The female pores are in 11/12 in line with *b*.

The spermathecal apertures are in 7/8 in line with *c*.

The body wall in *bc* near *b* is thrown into a longitudinal ridge on each side, extending from 9/10 to the setae of xi. Two papillae are seated on each ridge. The body wall between the two ridges is grayish instead of red. The whitish male porophores are on the posterior end of the ridges and are roughly conical with the pointed tip directed slightly inward and posteriorly. The anterior papillae



are larger, whitish, ovoid bodies with the long axis parallel to the long axis of the body. The papillae extend from just posterior to the setae of  $x$  to  $9/10$ , which is displaced slightly forward just in front of the papillae. The male porophores are incised by concentric circumferential furrows. The inner surface of the anterior papillae is smooth, flat, oval in outline, and the outer surface is incised by three or four longitudinal furrows.

On the posterior border of  $vii$ , in contact with  $7/8$ , and extending from just external to  $d$  to halfway between  $b$  and  $c$  on each side, is an oval smooth surfaced area marked off by a circumferential furrow.

*Internal anatomy.*—Septa  $5/6$ ,  $6/7$ ,  $7/8$ , and  $8/9$  are thickened.

The gizzards are four in  $xvii$ – $xx$ . The wall of the alimentary canal is thickened and whitish in  $xxi$ .

The last pair of hearts is in  $ix$ .

The testis sacs are asymmetrical. The sac on the right side is entirely in  $x$ . The sac on the left side is sharply constricted by  $9/10$  so that the anterior third of the sac lies in  $ix$ . The vas deferens is coiled into a globular mass, nearly half the size of the testis sac, or that portion of the sac which lies in  $x$ . The prostates have a finely granular surface, are slightly flattened or compressed antero-posteriorly, and stand erect in segment  $x$ . The vas deferens passes into the side of the prostate facing the nerve cord. The prostates are constricted as they pass into the parietes.

The ovarian chamber is closed dorsally. The ovisacs extend through segment  $xv$ .

The spermathecal ampulla is small and nearly globular. The duct is coiled under the ampulla and slightly looped as it passes along the septum. In and just anterior to septum  $7/8$ , on the parietes in the region of  $cd$ , is a hard oval body. The atrium is attached to the roof of this body close to  $7/8$ . The specimen is too poorly preserved to permit an adequate determination of the relations between the structures involved in this region.

*Distribution.*—Moulmein (October).

*Remarks.*—The length varies from 80–105 mm. and the diameter from  $4$ – $4\frac{1}{2}$  mm. The ridges on  $x$  and  $xi$  seem to be characteristic. The ridges with the papillae project from the body wall  $1\frac{1}{2}$ – $2$  mm.

The gizzards are four in  $xvii$ – $xx$ ,  $xviii$ – $xxi$ , or five in  $xvii$ – $xxi$ .

In some specimens at least the finger or sac-shaped structure in  $vii$  passes into the oval glandular body on the parietes in and near  $7/8$  and underneath the papilla on  $vii$ , and the surface of the papilla shows under high powers of the microscope two adjacent pores.

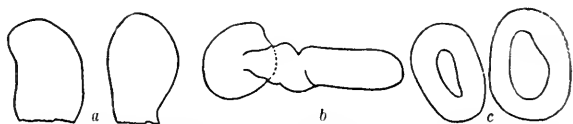


FIGURE 4.—DRAWIDA TUMIDA. a. PROSTATES  $\times 10$ . b. ATRIUM  $\times$  ABOUT 14. c. OPENINGS ON THE PAPILLA OF VII  $\times$  ABOUT 150

The condition of the specimens is such as to prevent a determination of the relationship of the spermathecal duct to the gland and the atrial (?) sac in vii.

**NOTOSCOLEX BIRMANICUS** Gates

*Notoscolex birmanicus* GATES, Ann. Mag. Nat. Hist., ser. 9, vol. 19, p. 609, 1927.

*Distribution.*—Maymyo, F. S. S. Probably widely spread throughout the Shan Plateau.

*Remarks.*—There are four pairs of calciferous glands in this species in segments ix–xii. Through a misprint the original description stated that they occurred in “segments ix–xiii.”

**NOTOSCOLEX DEPRESSUS**, new species

*Description of the type-specimen, external characteristics* (Cat. No. 19256, U.S.N.M.).—Length, 200 mm. Diameter, 3–6 mm. Number of segments, 334. Color: Unpigmented, very light grayish white color, except on the clitellum which is brownish red.

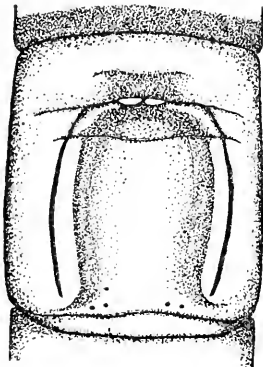


FIGURE 5.—*NOTOSCOLEX BIRMANICUS*. GENITAL REGION

The prostomium is probolous and withdrawn into the buccal cavity.

The first dorsal pore is in 9/10. Pores are also present in 10/11, 11/12, 12/13, and from 16/17 posteriorly.

Segments v–xii, inclusive, have a deep secondary furrow anterior to the setae. Segments vi–xii have in addition a deep secondary furrow posterior to the setae. Segments viii and ix have a slighter tertiary furrow on the posterior third of the segments. There are numerous furrows on xvii and xviii. Segments behind xviii usually have two secondary furrows, one anterior to and one posterior to the setae.

The setae are eight for each segment and begin on ii. Anterior to the clitellum *ab* is less than *cd*, and *aa* is less than *bc*. Just posterior to the clitellum *ab* is less than *cd*, and *aa* is about equal to two *bc*. More posteriorly still, *aa* and *bc* become nearly equal.

The clitellum begins behind the setae of xii and extends to 16/17 (about  $4\frac{1}{4}$ ), dorsal pores, except on 12/13, and intersegmental furrows are lacking.

The male pores are not visible externally, but according to the dissection open in the region *bc* on segment xvii.

The female pores are minute paired slits on xiii, anterior and slightly internal to seta *a* of the segment.

The spermathecal pores are in 6/7 and 7/8 in line with seta *c*.

The only genital marking is a horseshoe-shaped ridge on xvii and xviii. The opening of the horseshoe is directed posteriorly. The arms of the horseshoe are in the region *bc*, nearer *b* than *c*. The seminal grooves lie in this ridge, except anteriorly, where they turn off from the ridge and bend inwardly to end blindly on the anterior wall of the depression. The region within the ridge is depressed, the depression sloping more deeply anteriorly.

*Internal anatomy.*—Septa 6/7, 7/8, 8/9, 9/10, and 10/11 are thickened, 11/12 and 12/13 are slightly thickened.

The gizzard is slightly elongated in vi. Paired calciferous glands are attached to the alimentary canal in segments ix, x, xi, and xii. The intestine begins in xiv.

The last pair of hearts is in xii. Paired commissures are also present in segments vi–xii.

The testes and male funnels are free in segments ix and x. The seminal vesicles are small paired structures in x and xi on the posterior faces of the septa at the sides of the alimentary canal. The prostate extends through segments xvii–xxiv on the left side and xvii–xxiii on the right side. They lie at the sides of the alimentary canal and cover the dorsal surface of the intestine only in xxiii and xxiv where the posterior end of the gland is bent upward so as to come into contact with the dorsal blood vessel. The prostatic duct is nearly straight, about three millimeters long, and slightly flattened. The prostates are rather thick and are slightly flattened laterally.

The ovaries and oviduct funnels are in the usual positions but in segment xii. Both pairs of spermathecae are in segment vi. The ducts of the posterior pair pass back through 6/7 and vii and into the body wall in 7/8. The ducts of the anterior pair pass into the body wall in 6/7.

*Distribution.*—Maymyo, F. S. S.

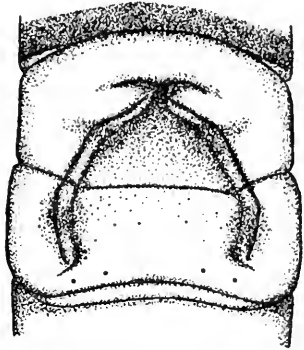


FIGURE 6.—NOTOSCOLEX DEPRESSUS.  
GENITAL REGION

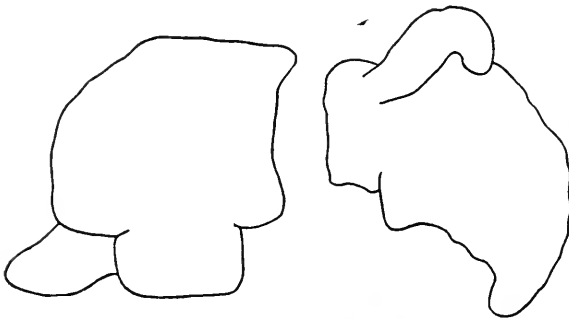


FIGURE 7.—NOTOSCOLEX DEPRESSUS. SPERMATHECAE  $\times$  ABOUT 15

*Remarks.*—The length of other specimens varies from 190–215 mm., and the diameter from 3–4 mm., at the posterior end, to 5–6 mm., at the thickest portion of the anterior end.

The prostomium is probobous in all specimens in which it is visible.

In one specimen the first dorsal pore is in 8/9, but is much smaller than the pore in 9/10.

The clitellum begins anywhere in the region from 12/13 to just behind the setae of xii, but practically always extends to 16/17, in a very few specimens ending just behind the setae of xvi.

The typhlosole begins in the clitellar region, occasionally in segment xiv, gradually diminishes in size posteriorly and ends 85–90 mm. from the anterior end.

The prostates lie in segments xvii–xxiv. The prostatic duct is 2–3 mm. long and is usually straight, sometimes bent slightly, less often coiled.

Both pairs of spermathecae are usually in vi, but occasionally the anterior pair is in v, in which case the ducts pass through 5/6, vi, and into the body wall in 6/7. The spermathecal duct is short and fairly stout. The ampulla is two to four times the length of the duct, club-, heart-, or irregularly shaped. The single short diverticulum is also rather variable. It may be a small wart-like projection from the spermathecal duct, or club-shaped, or more elongate and either straight or slightly bent at the free end.

**NOTOSCOLEX LUNATUS, new species**

*Description of the type-specimen, external characteristics* (Cat. No. 19262, U.S.N.M.).—Length, 201 mm. Diameter, 4–6 mm. Number of segments 314. Color: Unpigmented, very light grayish-white color, except the clitellum, which is brownish red.

The prostomium is small and withdrawn into the buccal cavity.

The first dorsal pore is in 9/10. Pores are also present in 10/11, 11/12, 12/13, and from 16/17 posteriorly.

Segments iv–xii, inclusive, have a deep secondary furrow posterior to the setae. Segments vi–viii have in addition a slighter furrow anterior to the setae. Segments ix–xii have a deep secondary furrow anterior to the setae. On the ventral side of segments vi and vii there are numerous short furrows perpendicular to the intersegmental and secondary furrows.

There are eight setae to each segment in four pairs. The first setae are on segment ii. Anterior to the clitellum the setae are small and not easily seen, but *ab* appears to be smaller than *cd*, and *aa* less than *bc*. Just posterior to the clitellum *ab* is very slightly less than *cd*, and *aa* and *bc* are about equal. More posteriorly *bc* gradually diminishes and becomes smaller than *aa*. Similarly *cd* diminishes so that *ab* and *cd* become equal.

The clitellum begins at 12/13 and extends to 16/17(4). Intersegmental furrows and dorsal pores are lacking.

The male apertures are not visible externally.

The female pores are minute paired slits on an oval whitish area just anterior to and internal to the setal lines *aa*.

The spermathecal apertures are minute openings in 6/7 and 7/8 in line with *a*.

The only genital marking is a deep depression on xvii and xviii between the setal lines *bb*. Furrows on the lateral walls of the depression mark off an oval area on each side on which is the seminal groove. These grooves are crescentic in shape with the concavity facing anteriorly and outwardly.

*Internal anatomy.*—Septum 5/6 is present, thin; 6/7, 7/8, 8/9, and 9/10 are thickened; 10/11 and 11/12 are slightly thickened.

The gizzard is slightly elongate in vi. Paired calciferous glands are present at the sides of the alimentary canal in segments ix, x, xi, and xii. The intestine begins in xiv.

The last pair of hearts is in xii.

The testes and male funnels are free in x and xi. The funnels are large. The seminal vesicles of xi are large, filling all of the available space in the segment

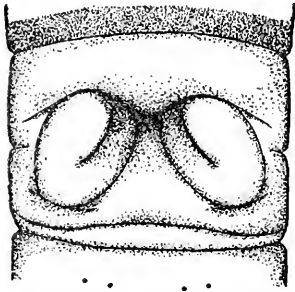


FIGURE 8.—NOTOSCOLEX LUNATUS.  
GENITAL REGION

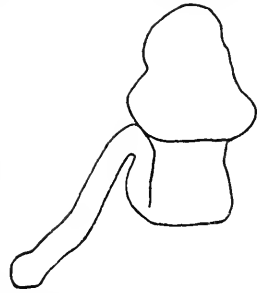


FIGURE 9.—NOTOSCOLEX LUNATUS. SPERMATHECA X ABOUT 15

and coming into contact over the dorsal blood vessel. A small rudiment of a seminal vesicle is present on the posterior face of 9/10 on the right side of the alimentary canal. The prostates extend through segments xvii–xx. The prostatic duct is short, thin, slightly flattened, and passes straight down into the parietes.

The ovaries and oviduct funnels are in the usual positions but in segment xii. The posterior pair of spermathecae is in vii and the anterior pair in vi.

*Distribution.*—Maymyo, F. S. S.

*Remarks.*—The length of other specimens varies from 155–205 mm. and the diameter from 3–4 mm. posteriorly to 4–6 mm. anteriorly.

The prostomium is epilobous but without the transverse furrow at the posterior edge of the tongue on segment i, in all specimens in which it is visible.

The first dorsal pore of all the specimens is in 9/10.

The clitellum begins at 12/13, or just behind the setae of xii, and ends just posterior to the setae of xvi or on 16/17.

All of the specimens except the type have a second large pair of seminal vesicles in segment x as well as xi. The prostates are flattened strap-shaped glands. The inner edge is straight, the outer edge incised, especially posteriorly. The duct is 1-2 mm. long, thin, flattened, and passes straight into the parietes.

The spermathecal duct is stout. The diverticulum is longer than the ampulla and duct together, narrowly tubular, bent in various ways, and only very slightly enlarged at the free end. The ampulla is roughly heart-shaped.

In coloration and general external appearance this worm is very similar to *N. depressus*. The two forms are readily differentiated, however, by the setal intervals, and the character of the ridges bearing the seminal grooves. *N. lunatus* appears to be much rarer than the other species as only eight specimens were secured. Four of the eight are short, broken-off head portions. Fifty-eight specimens of the other species were secured.

#### PHERETIMA MINUTA, new species

*Description of the type-specimen, external characteristics* (Gates collection).—Length, 43 mm. Diameter, 2-2½ mm. Number of segments, 90. Color: Unpigmented, very light grayish white, slightly darker on the dorsal surface anterior to the clitellum than elsewhere, clitellum pinkish.

The prostomium is epilobous, the tongue on segment i is short.

On segments v-ix, inclusive, there is a single deep secondary furrow posterior to the setae of the segment. On x-xiii there are two secondary furrows per segment, one anterior to and the other posterior to the setae of the segment. The setae are on ridges which are marked off, behind the clitellum, by more or less complete secondary furrows.

The first dorsal pore is in 12/13.

The setae begin on segment ii. The setal numbers are; v-32, ix-36, xii-37, xix-36. As a rule there is no break in the setal circles in the ventral region and the dorsal break is very slight. The last three segments have no setae, and the fourth segment from the last has only six setae, all in the ventral region.

The clitellum extends from 13/14 to 16/17 (3). It is ring shaped and complete on all the segments. Dorsal pores and intersegmental furrows are lacking; on the ventral side of segment xvi there are four setae.

The male pores are on segment xviii at the center of small round papillae, separated by 10 setae. The papillae have flat surfaces distinctly marked off by a circumferential furrow and are seated on very slight conical swellings in the body wall in the setal circle.

The female pore is on a small whitish oval area on xiv.

The spermathecal pores are four pairs in 5/6, 6/7, 7/8, and 8/9. There are 15 setae between the lines of the spermathecal apertures on viii.

The genital papillae are paired on vii, viii, and xix. On xx there is a single papilla on the right side just behind the papilla on xix. There are 4 setae on vii and viii between the centers of the papillae. There are 13 setae on segment xix between the centers of the papillae. The markings are small, round, and are located between the setae and the anterior furrow of the segment. Each papilla consists of a gray concave spot surrounded by a definite whitish rim or lip.

*Internal anatomy.*—4/5 and 5/6 are thin, 6/7 and 7/8 are slightly thickened, 8/9 is represented only by a ventral vestige attached to the longitudinal sheet of tissue underneath the gizzard, 9/10 may be partially fused with 10/11 or is absent, 10/11, 11/12, 12/13, 13/14, and 14/15 are very slightly thickened.

The length of the gizzard is slightly greater than the diameter. The intestine begins in xvi. Intestinal caeca extend from xxvii into xxiv. The last pair of hearts is in xiii.

The anterior testis-sacs are large and apparently lie within septum 10/11, but this septum may represent a fusion of 9/10 and 10/11 except where separated by the testes. A large portion of segment xi is shut off by connective tissue in such a way as to form a testicular chamber within which are enclosed the testes, and male funnels, the seminal vesicles, the alimentary canal, and the commissures. The seminal vesicles of xii are small, although larger than the vesicles of xi and are attached to the posterior face of 11/12 at the sides of the alimentary canal. The prostates are highly lobulated glands extending through xvii-xix. The prostatic duct is about  $1\frac{1}{2}$  mm. long and is slightly looped.

The ovaries and oviduct funnels are in xiii as usual. The spermathecae are in segments vi-ix and open anteriorly.

*Distribution.*—Lashio and Maymyo, F. S. S.

*Remarks.*—The length, diameter, and segmental numbers vary only slightly as the figures below, of five worms chosen at random, show;

|         | Length     | Diameter   | Number of segments |
|---------|------------|------------|--------------------|
|         | <i>mm.</i> | <i>mm.</i> |                    |
| a ..... | 35         | 2-2½       | 86                 |
| b ..... | 38         | 2½         | 91                 |
| c ..... | 42         | 2½         | 83                 |
| d ..... | 42         | 3          | 90                 |
| e ..... | 42         | 3          | 90                 |

The first dorsal pore is in 12/13 in all the specimens.

There are 10 to 12 setae between the male papillae; 12 is the number found most frequently. There are 14 to 16 setae between the lines of the spermathecal pores on segment viii. Setae are always present on the ventral region of the last clitellar segment (xvi), the number varies from 2 to 7. Setae are always lacking on the last 3 to 6 segments, and are usually few in number and confined to the ventral region on the last segment on which they occur.

The genital papillae are paired on one or more, or all, of segments vii, viii, xix, and xx, and are always located on the anterior border of the segment. Unpaired median papillae of the same size and appearance are occasionally present on the anterior region of one or more of the segments just mentioned.

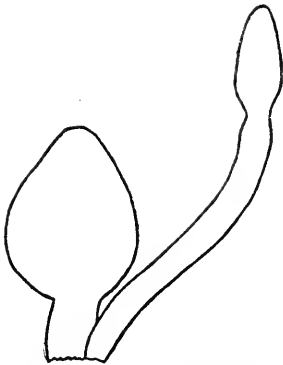


FIGURE 10.—*PHERETIMA MINUTA*.  
SPERMATHECA  $\times$  ABOUT 14

The prostate is often smaller than in the type and is sometimes represented only by a few nodules on the ental end of the prostatic duct. When the prostate is vestigial the duct is usually quite straight.

The spermathecal ampulla is conical and more than twice as long as the duct from which it is sharply delimited. The narrow tubular diverticulum is longer than the duct and ampulla together and is constricted near the ental end. The short portion beyond the constriction is slightly thicker than the rest of the diverticulum. Frequently the diverticulum ectal to the constriction is longer than the duct and ampulla together. The figure is characteristic, the spermathecae varying from one worm to another only in the length of the diverticulum.

***PHERETIMA ORNATA*, new species**

*Description of the type-specimen, external characteristics* (Cat. No. 19254, U.S.N.M.).—Length, 137 mm. Diameter, 6–8 mm. Number of segments, 106. Color: Dorsally bluish gray, ventrally very light grayish. The clitellum is darker with a reddish-brown tinge.

The prostomium is epilobous, but the furrow at the posterior end of the prostomial tongue on segment i is lacking.

On segments ix–xiii there are two secondary furrows per segment, one anterior to and the other posterior to the setae. Posterior to the clitellum there are usually two furrows per segment similarly placed.

The first dorsal pore is in intersegmental furrow 11/12.

The setae begin on segment ii and are located on distinct ridges from iii on. No setae are visible on the clitellar segments. The



numbers are v; 40, ix; 48, xii; 60, xix; 68, xxxiv; 70. There is a slight dorsal and ventral break in the setal circles.

The clitellum extends from 13/14 to 16/17(3). Dorsal pores and intersegmental furrows are lacking.

In the setal circle of xviii are two very slight conical swellings. Between these swellings there are 20 setae. At the tip of the swelling is a small round opening into a small concavity in the body wall. The lumen of the concavity is practically filled by a single, smooth-surfaced, cylindrical papilla which projects slightly beyond the edge of the opening into the concavity. At the tip of the papilla is the minute male pore. On the conical swelling there are four more or less complete concentric furrows, equidistant from each other and from the edge of the opening into the concavity.

The female pore is a single small opening at the center of an oval whitish area on xiv.

The spermathecal pores are in 7/8 and 8/9 about one-half of the circumference apart. There are 25 setae on segment viii between the lines of spermathecal pores.

The only further genital markings on this specimen are a pair of papillae on segment xviii. These structures are the same in size and appearance as those bearing the male pores. Each papilla is located on the edge of the conical swelling internal to the male pore and slightly anterior to the setae. Each has at the free end a small pore;

*Internal anatomy.*—Septa 5/6, 6/7, and 7/8 are thickened; 8/9 is missing; 9/10 is not attached normally to the parietes, but is represented by a delicate sheet of tissue lying against 10/11 in such a way as to inclose a small medio-ventral space containing the anterior testis-sacs and the vascular commissure of segment x. Septa 10/11, 11/12, 12/13, and 13/14 are thickened.

The gizzard is nearly spherical and occupies the spaces of segments vii, viii, and ix. The intestine begins in xv. The intestinal caeca extend from xxvii into xxiii on the right side and into xxii on the left side.

There are two pairs of commissures in the combination gizzard segment. The anterior pair passes to the gizzard. The right commissure of the next pair is atrophied. The commissures of x are not visible until 9/10 is dissected off. The last pair of "hearts" is in xiii.

There are large nephridial masses dorso-lateral to the alimentary canal in v and vi.

The anterior testis-sacs are on the anterior face of 10/11 covered over by the rudiment of 9/10. The posterior pair of testis-sacs are in the usual positions in xi. The paired seminal vesicles are in xi and xii, those of xii smaller than the ones in xi. The vesicles are not very large and are well down on the sides of the alimentary canal. The prostates are small and confined to xvii and xviii. Each gland

has three or four large lobes marked off by deep incisions and each lobe is composed of several lobules. The duct is S-shaped and variously placed. Near the prostate on each side is a single gland with a duct which passes into the body wall and opens to the exterior through the pore on the tip of the papilla on xviii near the male pore.

The ovaries and oviduct funnels are in the usual positions in segment xiii. On the posterior face of 12/13 at each side of the intestine is an elongate club-shaped structure that may be an ovisac. The two pairs of spermathecae lie in combination gizzard segment and open anteriorly. Near each spermatheca is a single glandular mass with a duct similar in appearance to the glands located near the prostates.

*Distribution.*—Lashio, F. S. S.

*Remarks.*—The length of other specimens varies from 120–140 mm., and the diameter from 5–6 mm., at the posterior end, and 7–8 mm., at the anterior end.

The posterior furrow at the end of the prostomial tongue on segment i is lacking on all but one of the worms.

Two secondary furrows may be present on any segment posterior to v.

The first dorsal pore is in 11/12 in all of the worms. In many specimens the positions of the dorsal pores on the clitellum are indicated by pore-like depressions in the thickened epidermis, but in none of these worms are there functional pores on the clitellum.

The setal circles are usually without a ventral break; the dorsal break is small, about 2 *yz*. The setae are located on distinct ridges.

The papillae bearing openings of the ducts of glands of the prostatic region are usually absent and when present vary in number. Three specimens have a pair of such papillae as in the type. Two have two pairs, the second pair posterior to the setae. One worm has one papilla on the right side. The pore bearing papillae are placed so as to occupy the entire space between two consecutive furrows on the slope of the conical swelling.

The number of setae between the male papillae varies from 18–24, 21 the number most commonly found. The number of setae on viii between the lines of the spermathecal pores varies from 23–28, 24, 25, or 26, the numbers most commonly found.

Setae from various dorsal and ventral positions anterior to the clitellum and various ventral positions posterior to the clitellum were examined microscopically. All such setae have ornamented outer ends, the ornamentation consisting of short transverse rows of very fine teeth.

The last 10 septa are much thickened in all specimens examined.

The ventral edges of the intestinal caeca are incised or lobed in such a way as to form ventrally projecting secondary caeca. The

typhlosole is simple: it begins in the region of xxvii and ends gradually 10 to 15 segments from the posterior end.

The commissure belonging to the left side of segment ix is atrophied in all specimens. The commissures of x and xi as well as the right commissure of ix pass into the ventral vessel. On each side of the dorsal vessel in the posterior part of the segment, from about the middle of the worm posteriorly, is a small glandlike body. Smaller and more transparent glands are similarly attached to the dorsal vessel anteriorly.

The vasa deferentia of a side come into contact and join in the posterior part of segment xii.

The club-shaped bodies (ovisacs?) from the posterior surface of 12/13 were examined microscopically but no ova were found.

The spermathecal duct is short and sharply delimited from the ampulla which is about two to two and one-half times as long as

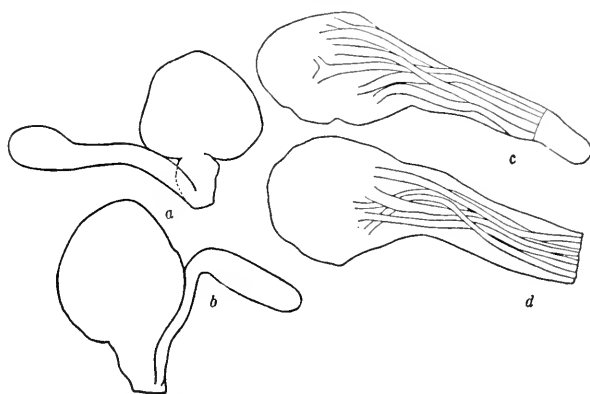


FIGURE 11—*PHERETIMA ORNATA*. a, b. SPERMATHECAE  $\times$  ABOUT 8. c. GLAND FROM THE PROSTATIC REGION  $\times$  ABOUT 20. d. GLAND FROM THE SPERMATHECAL REGION  $\times$  ABOUT 27

the duct. The ampulla is usually more or less heart-shaped. The diverticulum consists of a duct more than twice as long as the spermathecal duct and an ental enlargement which is usually round (fig. 11a) but which may be occasionally much elongated (fig. 11b). Intermediate conditions are found.

The glandular masses located near the spermathecae and the prostates are very similar in appearance when examined in glycerine. Those from the prostatic region (fig. 11c) are one and one-half to two times the size of those from the spermathecal region (fig. 11d). The ental end of the gland is roughly ovoid and the stalk consists of transparent tissue in which lie 6-10 ducts.

Only one species of *Pheretima* with spermathecal pores in 7/8 and 8/9 has been recorded from India up to the present time and this form (*P. andamanensis* Michaelsen 1907) is quite evidently different from the worm just described. The literature on the genus *Pheretima* is

extensive and widely scattered and some is not available to the writer. There is, therefore, a possibility that the species just described above is not new.

**OCTOCHAETUS LUNATUS, new species**

*Description of the type-specimen, external characteristics* (Cat. No. 19255, U.S.N.M.).—Length, 94 mm. Diameter, 3–5 mm. Number of segments, 167. Color: Very light grayish, except the clitellum, which is reddish.

The prostomium is prolobous.

On segments v–xii there is a deep secondary furrow posterior to the setae of the segment. On segments vii–xi there is a secondary furrow anterior to the setae of the segment. On segments vii–ix there is a slight tertiary furrow on the posterior third of the segment. Posterior to the clitellum there are usually two secondary furrows per segment, one anterior to and one posterior to the setae of the segment.

The first dorsal pore is in 12/13.

The setae are eight to each segment and begin on ii. Posterior to the clitellum *cd* is nearly twice *ab* and is less than *bc*, *aa* and *bc* are about equal. Posteriorly *bc* diminishes until it becomes distinctly less than *aa*. The dorsal distance is greater than one half of the circumference.

The clitellum extends from 12/13 to 18/19 (6). It is ringshaped and complete except on xvii and xviii where it is interrupted by the male area in *aa*. Intersegmental furrows and dorsal pores are lacking. Setae are present.

The male pores are in xviii, just internal to *a*, in the seminal grooves.

The female pores are paired in *aa* on xiv, each pore at the center of a minute transversely oval papilla, the two papillae contiguous at the center.

The spermathecal pores are paired in *aa* on viii and ix, in line with the eight setae of the segment. They are about the same size and as readily visible as the female pores.

The only genital markings are the seminal grooves which extend across xviii onto the anterior portion of xix and the posterior portion of xvii. The grooves are crescent-shaped and just internal to *a*. The body wall between the two grooves is whitish.

*Internal anatomy.*—Septum 4/5 is present and thickened; 5/6, 6/7, and 7/8 are absent; 8/9, 9/10, 10/11, and 11/12 are thickened and very close together; 12/13 is very slightly thickened. Septa 10/11 and 11/12 are bound together by a connective tissue in such a way as to close off a central portion of segment xi as a sort of testicular chamber which must be opened before the contents can be seen.

The diameter of the gizzard is nearly twice the length. The calciferous gland of the left side is almost entirely in xv, the gland of the right side is in xvi. The glands are large, dark red, and flattened antero-posteriorly. The intestine begins in xvii.

The last pair of hearts is in xiii. There are three pairs of commissures belonging to segments vi, vii, and viii posterior to the gizzard under 8/9; anterior to the gizzard and just posterior to 4/5 is another pair of commissures, belonging to segment v. The dorsal vessel passes through 4/5 and anteriorly.

There is a large mass of nephridia dorso-lateral to the alimentary canal in iv.

The testes and male funnels are in x and xi, the funnels of xi slightly larger than the funnels of x. The seminal vesicles are small and attached to the posterior face of 11/12 at the sides of the alimentary canal. The prostates are small and flattened, the anterior pair in xvii and the posterior pair in xix. The duct is short and nearly straight.

The ovaries and oviduct funnels are in the usual positions in xiii. The spermathecae are on the parietes of viii and ix. The ampulla is in contact with the nerve cord and the duct is in the body wall. There is a single short diverticulum.

*Distribution.*—Mandalay.

*Remarks.*—The length varies from 70–100 mm., and the diameter from 2–3 mm. at the posterior end, to 4–5 mm. at the anterior end.

Setal interval *bc* may be distinctly smaller than *aa* or about equal to *aa*.

The prostates are 2–5 mm. long, and the duct is  $\frac{1}{2}$ – $\frac{3}{4}$  mm. long.

#### EUTYPHOEUS BIFOVIS, new species

*Description of the type-specimen, external characteristics* (Cat. No. 19257, U.S.N.M.).—Length, 240 mm. Diameter, 6–8 mm. Number of segments, 197. Color: Deep rich brown.

The prostomium is prolobous.

On segments ii to xii, inclusive, there is a deep secondary furrow, posterior to the setae of the segment. On segment v there is in addition a slighter furrow, posterior to the setae. On segments vi to xii, inclusive, there is a deep furrow posterior to the setae. On ix and x there is a slighter tertiary furrow on the anterior and posterior thirds of the segments, while on xi and xii there is a single tertiary slight furrow on the posterior third only. Segment xiii has a single deep secondary furrow anterior to the setae. Posterior to the

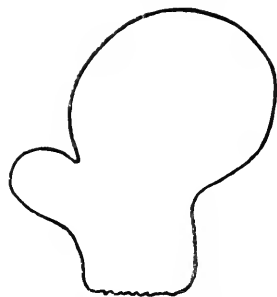


FIGURE 12.—OCTOCHAETUS LUNATUS. SPERMATHECA X ABOUT 45

clitellum there are on many of the segments two slight secondary furrows, one anterior to and the other posterior to the setae of the segment.

The first dorsal pore is in 10/11. Dorsal pores are also present in 11/12 and from 17/18 posteriorly. There are pore like depressions in 12/13 to 16/17 but no functional pores are present in these furrows.

The setae are eight to each segment, in four pairs, and begin on ii. Anterior to the clitellum *ab* is about equal to *cd*, and *bc* and *aa* are about equal. Posterior to the clitellum *ab* is less than *cd*, and *bc* is less than *aa*. Toward the tail *ab* and *cd* tend to become equal, but *aa* remains larger than *bc*. The dorsal distance is slightly greater than one-half the circumference.

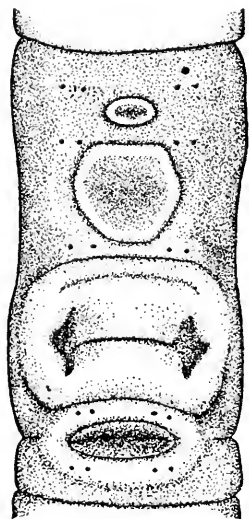


FIGURE 13.—EUTYPHOEUS BIFOVIS. GENITAL AREA

The clitellum extends from 13/14 to 17/18 (4). There are no intersegmental furrows visible between the clitellar segments.

The male pores are on xvii in *bc*, just external to *b*. Each pore is on the center of a smooth, glistening, flat-topped area which lies at the bottom of a deep longitudinal depression in the region *ab* on segment xvii.

The female aperture is single, on the left side only, anterior to and very slightly internal to seta *a*.

The spermathecal pores are one pair in 7/8 in the region *cd*.

There are three genital markings. The anteriormost is a circular area between setae *ab* of segments xv and xvi and extending at the middle to just beyond the setal lines *b*. This area is concave, lighter in color than the rest of the clitellum, and sharply delimited by a circumferential furrow. An area similarly colored and delimited and also concave, but oval in shape lies across 18/19 from the setae of xviii to the setae of xix and included between the setal lines *bb*. The long axis of the oval area is perpendicular to the long axis of the animal. The other marking is an oblong-shaped, whitish region extending from the setae of xvi to the setae of xviii, with the longer axis of the region along the long axis of the worm. The area is sharply delimited by furrows only on the anterior and posterior margins. In the region *ab* on each side is a deep longitudinal depression into the body wall.

*Internal anatomy.*—Septa 4/5 and 5/6 are present and thickened, the latter more than twice the thickness of the former; 6/7 and 7/8

are absent; 8/9, 9/10, and 10/11 are much thickened and displaced backward together; 11/12 is represented only by thin connective tissue which forms the median testicular chamber. The remaining septa are thin and attached normally.

The gizzard is bell-shaped with a posterior flange. There are calciferous glands in the wall of the alimentary canal in segment xii. The intestine begins in xv.

The supra-pharyngeal and sub-pharyngeal ganglia are bright yellow but the circum-pharyngeal connectives, the nerves, and the ventral nerve cord are whitish as usual.

There are large tufted masses of nephridia adherent to the parietes in segment iii.

There are two pairs of vascular commissures under septum 8/9. The last pair of "hearts" is in segment xiii. The commissures of xi lie within the testicular chamber on the posterior face of 10/11.

The testes and male funnels are included within the median testicular chamber. The seminal vesicles are in contact with 10/11 anteriorly and posteriorly push 12/13 back into contact with 13/14. The prostates are in xviii-xx, and are tubular. The ducts are in xvii and are coiled into an S shape.

The ovaries and oviduct funnels are in the usual positions in segment xiii. The spermathecal ampulla is elongated in the direction of the main axis. The duct is very short and almost entirely confined to the body wall. Each spermatheca has two diverticula, one on each side of the duct. The diverticula consist of three to seven seminal chambers arranged together as an elongate row or as a club-shaped body, and are nearer together posteriorly than anteriorly.

There are glandular thickenings of the ventral parietes in the region of the anterior and posterior genital markings.

*Distribution.*—Mandalay.

*Remarks.*—The length of the other specimens varies from 180–245 mm., and the diameter from 6–8 mm.

The first dorsal pore is usually in 17/18, rarely in 13/14, although nonfunctional porelike depressions occur between 10/11 and 17/18.

The clitellum begins at 12/13 or somewhere between 12/13 and 13/14 and always extends to 17/18.

Two worms have a genital marking on 14/15 between setal lines *aa*, which is light in color, concave, but not as sharply delimited as the other two similar areas.

The typhlosole begins in the region immediately behind the clitellum and ends 65–70 mm. from the posterior end of the worm in the region of the supra-intestinal glands. These glands are 12 pairs, 2 pairs in each of 6 successive segments.

The oviduct funnels are small and have thick rounded rims.

The vasa deferentia are looped in xii and xiii and then pass straight back into xviii and under the prostatic ducts. Each vas deferens then bends in toward the nerve chord and is enlarged into an egg-shaped body which is buried in the parietes just behind the prostatic duct. The prostatic duct is usually 14–15 mm. long. The prostates are 55–65 mm. long.

The penial setae are 3 mm. or less in length, 15–25 micra thick near the tip, and 35–40 micra thick at the place of greatest enlargement near the inner end. The shaft is curved into a slight suggestion of a spiral but is flattened out by pressure of the cover glass into a wide arc. The tips of most of the setae examined are either missing or obviously deformed or softened. In the few undamaged setae the tip is bent slightly and hollowed out into a spoon shape. The ornamentation begins very close to the tip, extends 0.4–0.5 mm. along the shaft, and consists of numerous ridges of very fine teeth. The teeth are close together and the rows of teeth are not frequently broken and are fairly regularly spaced.

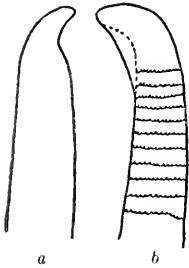


FIGURE 14.—EUTYPHOEUS BIFOVIS. a. PENIAL SETA  $\times$  ABOUT 450. b. PENIAL SETA  $\times$  ABOUT 475.

The clitellar and preclitellar setae have ornamentation similar to that on the penial setae, but the toothed ridges are more frequently broken and farther apart and not so regularly spaced.

EUTYPHOEUS CONSTRICTUS, new species

*Description of the type-specimen, external characteristics* (Cat. No. 19261, U.S.N.M.).—Length, 122 mm. Diameter, 4–6 mm. Number of segments, 224. Color: Very light grayish white, except the clitellum which is reddish.

The prostomium is probolous and partially withdrawn into the buccal cavity.

On segments iv–xii there is a deep secondary furrow posterior to the setae of the segment. On vi–xii there is a deep secondary furrow anterior to the setae of the segment. There are slight furrows on xiii anterior to the setae. Posterior to the clitellum there are two slight secondary furrows per segment.

The first dorsal pore is small and is in 10/11. Pores are also present in 11/12, 12/13, 13/14, 16/17, and posteriorly. There are non-functional pore-like depressions in 14/15 and 15/16.

The setae are eight to each segment and begin on ii. They are fine and in places on the anterior segments are retracted into the body wall. Behind the clitellum  $ab$  is about equal to one-half of  $cd$ ,  $bc$  is greater than  $cd$  and less than  $aa$ ,  $dd$  is greater than one-half of the circumference.

The clitellum extends from just anterior to the setae of xiii to 17/18 ( $4\frac{1}{2}$ ). It is ring shaped and complete except on the ventral



portion of xvii where it is interrupted by the male area. Setae are present except *ab* of xvii. Intersegmental furrows are lacking.

The male apertures are transverse slits in *ab* on xvii.

The female pores are paired diagonal slits on xiv anterior and just internal to seta *a*.

The spermathecal pores are in 7/8, large. The body wall around the pore is swollen and fissured.

The only genital marking is a slight, dumb-bell shaped elevation on xvii, in *cc*. Much of the anterior edge is straight, the posterior edge impinges on the anterior portion of xviii. In *ab* on each side is a slight conical elevation on which are located the male apertures.

*Internal anatomy.*—Septa 4/5 and 5/6 are thickened, especially 5/6; 6/7, and 7/8 are missing, 8/9, 9/10, 10/11 are thickened and displaced backwards together; 11/12 is missing or represented only by a ventral vestige.

The gizzard is wider than it is long. Calciferous glands are embedded in the wall of the alimentary canal in segment xii. The intestine begins in xv.

There are three pairs of commissures in the gizzard segment, one pair anterior to the gizzard and two pairs posterior to the gizzard under 8/9. The last pair of hearts is in xiii. The supra-intestinal glands are in six successive segments about 55 mm. from the anterior end of the worm. The last pair of glands is much enlarged and very dark red in color.

There are tufted masses of nephridia adherent to the parietes of segment iii.

The testes and male funnels are enclosed in a median testicular chamber. The seminal vesicles extend from 10/11 to 12/13, pushing 12/13 and 13/14 into contact with 14/15. There is a small pair of male funnels on the anterior face of 10/11. The prostates extend through xvii and xviii. The duct is short and looped twice. The vasa deferentia come into contact in xiii and run posteriorly side by side without fusion, into xviii. The fused deferent duct is enlarged as it passes into the parietes immediately behind the penial setae.

The ovaries and oviduct funnels are in the usual positions in xiii. The spermathecal ampulla is firm and stands erect in the segment. The duct is short and practically confined to the body wall. There are two diverticula, one on each side of the duct.



FIGURE 15.—EUTYPHOEUS  
CONSTRICTUS. PENIAL  
SETA, DRAWN FROM A  
MICROPHOTOGRAPH



FIGURE 16.—EUTYPHOEUS  
CONSTRICTUS. SPERMATHECAL  
DIVERTICULUM  
× ABOUT 14

*Distribution.*—Meiktila.

*Remarks.*—The length varies from 110–130 mm., the diameter from 3–4 mm., at the posterior end to 6–7 mm. at the anterior end. In a few specimens the first dorsal pore is large and located in 11/12.

The prostates are 21–25 mm. long, the duct is 2–4 mm. long. The spermathecal diverticula have a wide variety of shapes. In one specimen the diverticulum on one side of the duct may be elongate and finger shaped, while the diverticulum on the other side of the duct is club shaped with numerous small nodules on the end.

The penial setae are 1.5–1.8 mm. long; 48–52 micra thick at the widest portion of the base, and 48–65 micra thick at the widest region near the tip. The shaft is straight except for a single bend near the tip. Near the free end of the seta there are two or three distinct, transverse constrictions or grooves completely continuous around the shaft. The first 0.5–0.7 mm. of the tip end of the seta is ornamented with short rows of teeth. The rows are quite regularly and fairly closely spaced.

**EUTYPHOEUS EXCAVATUS, new species**

*Description of the type-specimen, external characteristics* (Cat. No. 19260, U. S. N. M.).—Length, 274 mm. Diameter, 6–10 mm. Number of segments, about 254.

Color: Deep rich brown. The prostomium is probolous, large.

On segments ii–xii there is a deep secondary furrow posterior to the setae of the segment. On iv–xii there is a deep secondary furrow anterior to the setae of the segment. Tertiary furrows are present as follows: vi, one on the posterior third; vii, one on the posterior third; viii, two on the posterior third; ix, one on the anterior third and two on the posterior third; x, one on the anterior third and one on the posterior third; xi and xii, one on the posterior third. On xiii there is one furrow anterior to the setae. Behind the clitellum nearly every segment has two deep secondary furrows, one anterior and one posterior to the setae. Many of the segments have a tertiary furrow on the anterior and posterior thirds formed by the secondary furrows.

The first dorsal pore is in 11/12. Pores are present in 12/13, 17/18, and posteriorly.

There are eight setae and they begin on segment ii. Posterior to the clitellum *ab* and *cd* are about equal, *bc* is less than *aa*, *dd* is greater than one-half of the circumference.

The clitellum extends from the secondary furrow anterior to the setae of xiii to 17/18 (about  $4\frac{1}{2}$ ). Intersegmental furrows and dorsal pores are lacking. The clitellum is interrupted ventrally by the genital markings and the depression on xvii.

The male pores are in line with or very slightly external to *b* at the center of white glandular areas at the bottom of the depression on xvii.

The female pore is single, anterior and very slightly internal to *a*, on the center of a small, oval, whitish area on the left side of xiv.

The spermathecal apertures are in 7/8 in line with *b*.

The genital markings are the deep depression on xvii and two bluntly oval, large, median papillae on 14/15 and 15/16. These papillae are whitish, smooth-surfaced, slightly concave areas which extend externally to just beyond the line *b*, and antero-posteriorly nearly to the setae of the segments concerned. The posterior papilla is slightly smaller than the anterior, and both are delimited by sharp circumferential furrows. On xvii is a transversely elongate slit in *cc* opening into a depression in the parietes 2–3 mm. deep. The body wall around the aperture is swollen, especially around the ends of the slit. On the anterior and the posterior walls of the depression, in the region *bb*, are paired smooth-surfaced glandular areas. Columnar porophores, present in closely related Burmese species of the genus, are entirely lacking here.

*Internal anatomy.*—Septa 4/5 and 5/6 are present and much thickened, especially 5/6; 6/7 and 7/8 are absent; 8/9, 9/10, and 10/11 are thickened and displaced backwards together; 11/12 is absent or is represented only by the connective tissue forming the wall of the testicular chamber. This chamber is in the shape of a U inverted over the alimentary canal.

The diameter of the gizzard is slightly greater than the length; there is a slight rim on the posterior end. There are calciferous glands in the wall of the alimentary tract in xii. The intestine begins in xv.

There are large tufted masses of nephridia adherent to the parietes of segment iii.

The dorsal blood vessel ends with the more anterior of the two pairs of commissures under 8/9. The last pair of hearts is in xiii.

The testes and male funnels are in the testicular chamber. The seminal vesicles are large, extending from 10/11 to 12/13 which is pushed back into contact with 13/14. The tubular prostates extend through xviii–xx and xviii–xxi. The duct is long and looped in xvii and xviii.

The vas deferens passes under the prostatic duct, turns in toward the nerve cord, and is enlarged as it passes into the parietes.

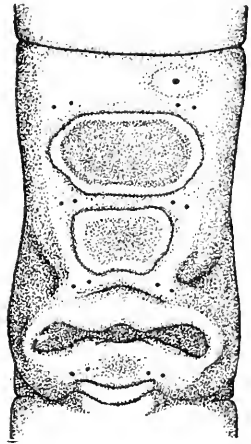


FIGURE 17.—EUTYPHOEUS EXCAVATUS. GENITAL REGION

The ovaries and oviduct funnels are in the usual positions in segment xiii. The spermathecal ampulla is large, flattened out dorsally by the gizzard. The duct is short and practically confined to the body wall. The single diverticulum is on the outer side of the duct and consists of four elongate, finger-shaped seminal chambers placed side by side.

The parietes are thickened in the region of the median genital markings.

*Distribution.*—Meiktila (October).

*Remarks.*—The length varies from 190–280 mm. The first dorsal pore is in 11/12 in all specimens. The clitellum begins just anterior or just posterior to the setae of xiii and extends to 17/18.

Setal intervals *ab* and *cd* vary somewhat, *ab* and *cd* usually equal, but in some specimens *ab* is noticeably smaller than *cd*. Interval *aa* is larger than *bc* on all the worms.

On several of the specimens there is a minute depression on segment xiv, where the female pore of the right side would ordinarily be located, but no actual pore can be seen.



FIGURE 18.—EUTYPHOEUS  
EXCAVATUS. SPERMA-  
THECAL DIVERTICULUM  
× ABOUT 14

The genital markings are quite characteristic, just one worm from a large number differing from the type. In the exceptional specimen there is a third genital papilla, about the same size as the posterior marking, located between the setae of segments xiii and xiv.

There are 12 pairs of supra-intestinal glands in 6 successive segments about 85–95 mm. from the anterior end.

The prostatic duct is 14–16 mm. long.

The spermathecal ampulla is variously shaped and often consists of three to seven elongate seminal chambers arranged as in the type specimen. Frequently the chambers are round, more numerous, and so arranged on the free end of the diverticulum as to produce a berry-like appearance.

The penial setae are 4–5 mm. long, 46–54 micra thick near the base, and 48–52 micra thick near the tip. The shaft has two long curvatures, the concavity of the first half of the seta on the opposite side from the concavity of the second half. The ornamentation consists of short rows of three to five teeth, or of single teeth scattered over the first 0.8–0.9 mm. of the tip.

EUTYPHOEUS HASTATUS, new species

*Description of the type-specimen, external characteristics* (Cat. No. 19259, U.S.N.M.).—Length, 92 mm. Diameter, 2–4 mm. Number of segments, 211. Color: Grayish, except the clitellum which is deep brownish red.

The prostomium is probolous, large.

On segments iv–xii, inclusive, there is a deep secondary furrow posterior to the setae of the segment. On segments vi–xii there is a second deep furrow posterior to the setae of the segments. On viii there are two slight tertiary furrows, one on the anterior third and one on the posterior third of the segment. On ix there are two slight tertiary furrows on the anterior third and one on the posterior third of the segment. On x there is a single tertiary furrow on the anterior third of the segment. Posterior to the clitellum there are two secondary furrows per segment, one just anterior to and the other just posterior to the setae.

The first dorsal pore is in 10/11. Pores are also present in 11/12, 12/13, 13/14, 17/18 and posteriorly. There is a nonfunctional pore-like depression on 16/17.

The setae begin on ii, and are paired. Posterior to the clitellum *ab* is less than *cd* which is less than *bc*, *aa* is greater than *bc*, *dd* is greater than one half of the circumference.

The clitellum begins just anterior to the setae of xiii and extends to 17/18. It is interrupted ventrally on xvii by the male papillae. Intersegmental furrows are lacking. All setae are present in normal positions except *ab* on xvii.

The male apertures are on xvii, just external to *b*. Two dark red setae project through each aperture.

The female pores are on xiv. The right pore is just anterior to seta *a*, the pore on the left side is anterior to and very slightly internal to *a*.

The spermathecal apertures are in 7/8 in line with *c*.

The paired male papillae are oval, sharply delimited, and slightly slantwise so that the anterior ends point toward each other. Each papilla extends from just internal to *a*, nearly to *c*. On the posterior part of the marking is a slight conical elevation bearing at the tip the male pore. Two sharply delimited oval papillae lie in *aa* on xviii.

*Internal anatomy.*—Septa 4/5 and 5/6 are present and thickened; 6/7 and 7/8 are absent; 8/9, 9/10, and 10/11 are thickened and displaced posteriorly, close together; 11/12 is very thin and attached to the parietes ventrally and laterally close to 10/11, dorsally the two septa are in contact so that the seminal vesicles appear to be in contact with 10/11; the remaining septa are thin and attached normally.

The gizzard nearly fills segments vi–viii. There are calciferous glands in the wall of the alimentary canal in xii. The intestine begins in xv.

There are nephridial masses on the parietes in the region of segment iii.

There are three pairs of commissures in the combined gizzard segment, two under 8/9 posterior to the gizzard, and one just behind 5/6, anterior to the gizzard. The dorsal vessel continues anteriorly through iv and v. Lateral commissures are also present in segments ix-xiii.

The anterior pair of testes and funnels are free in x. Segment xi is reduced in size by the nearness of 10/11 and 11/12, ventrally, and their apposition and fusion (?) dorsally. The reduction is increased by the presence laterally of delicate connective tissue between the two septa. When the worm is first opened from the dorsal side, the segment is not at first noticeable, as only three septa are visible between the gizzard and 12/13. The last of these septa appears to be much thicker than the other two. The apparent thickness of the septum is due to the presence between 10/11 and 11/12 of testicular material of the same color as the septa. After cutting open the roof of the testicular chamber 11/12 can be traced

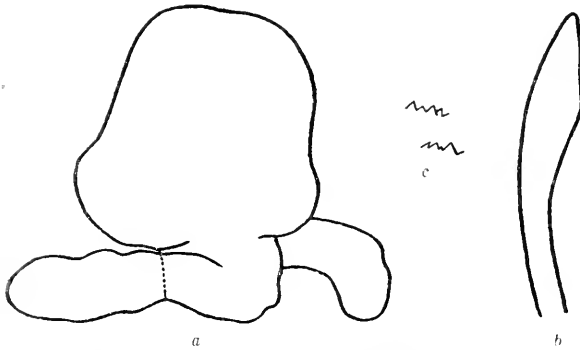


FIGURE 19.—EUTYPHOEUS HASTATUS. *a.* SPERMATHECA  $\times$  ABOUT 16. *b.* TIP OF PENIAL SETA  $\times$  ABOUT 91. *c.* ORNAMENTATION OF PENIAL SETA, OIL IMMERSION

to the parietes ventro-laterally and ventrally. On the floor of the chamber is the second pair of male funnels. The anterior pair of seminal vesicles is in ix, the vesicles are small and lobed. The posterior vesicles are much larger, extending from 10/11

to 12/13, pushing 12/13 and 13/14 into contact with 14/15. The prostates are small, tubular, and extend through xvii-xx. The duct is in xvii, short, and looped once or twice.

The ovaries and oviduct funnels are in the usual positions in xiii. The single pair of spermathecae is in the combined gizzard segment.

*Distribution.*—Prome, Thayetmyo.

*Remarks.*—Length 85-95 mm. Diameter, 2-2½ mm. posteriorly to 4-5 anteriorly. The first dorsal pore is in 10/11 in all specimens. Setal interval *aa* varies from 1½-2 *bc*. The spermathecal pores are in *b*, *c*, or between *b* and *c*.

The unpaired median papillae are in the region *aa*, extending anteriorly and posterior nearly to the intersegmental furrows of the segment. There are one, two, or three of these markings, located on segment xviii, or on xviii and xix, or xviii, xix, and xx. A few specimens have a pair of papillae in xviii instead of the single papilla.

The penial setae are 3–4 mm. long, 66–74, micra thick at the widest region of the tip, 50–52 micra thick at the narrow region just behind the tip, and 52–56 micra thick at the inner end. The shaft is nearly straight except for a slight bend near the diamond-shaped enlargement at the tip, and is ornamented by short sparsely distributed, toothed ridges.

The spermathecal ampulla is more or less heart shaped, two to three times the length of the duct. An elongate diverticulum is attached to the right and to the left sides of the base of the duct.

The prostates extend through xvii–xxi or xviii–xxii, and are 18–24 mm. long. The duct is 1–2 mm. long. The vasa deferentia of a side come into contact in xii but do not fuse until after they have passed under the prostatic duct and turned inwards toward the nerve cord. The fused duct is enlarged for two or three millimeters before passing into the parietes.

**EUTYPHOEUS PLANATUS, new species**

*Description of the type-specimen, external characteristics* (Cat. No. 19258, U.S.N.M.).—Length, 120 mm. Diameter, 5–8 mm. Color: Deep rich brown. Number of segments, 149.

The prostomium is prolobous, large.

On segments ii–xii, inclusive, there is a deep secondary furrow posterior to the setae of the segment. On segments v–xii, inclusive, there is a second deep furrow posterior to the setae of the segment. On vi–ix there is a slight tertiary furrow on the posterior third of the segments. On viii–x there is a slight tertiary furrow on the anterior third of the segments. Posterior to the clitellum there are two slight secondary furrows on each segment, one anterior to and one posterior to the setae of the segment.

The first dorsal pore is in 11/12. There are pores in 12/13, 17/18, and posteriorly.

The setae are eight per segment, they begin on segment ii. Anterior to the clitellum  $ab$  is less than  $cd$ , and  $aa$  is greater than  $bc$ . Posterior to the clitellum  $ab$  is less than  $cd$  and  $bc$  is  $2/3$  to  $3/4$   $aa$ ,  $dd$  is greater than one-half of the circumference.

The clitellum begins just behind the setae of xiii and extends to 17/18. No dorsal pores or intersegmental furrows are present. Setae are present in normal positions with the exception of  $a$  and  $b$  on each side of xvii.

The male apertures are conspicuous openings in the region  $bc$ , at the top of tubular porophores projecting from the bottom of the depression in the body wall on xvii.

The female pore is single, anterior to the setae, about halfway between setal lines  $a$  and  $b$ , at the bottom of a slight concavity on the left side of segment xiv.

The spermathecal pores are in  $7/8$  in *bc*, close to *b*.

There are two genital markings. The anterior marking is an elongate, oval, lighter colored depression on  $13/14$ , extending from the setae of *xiii*, to the setae of *xiv*, and laterally on each side to about half way between *b* and *c*. The posterior marking is a deep depression in the body wall of *xvii*, in *bb*. On the floor of this depression in the region *aa* are four elongate white papillae. External to these papillae and also on the floor of the depression are the columnar male porophores. The body wall around the mouth of the depression lacks the brown pigment and is much wrinkled.

*Internal anatomy.*—Septa  $4/5$  and  $5/6$  are much thickened, especially  $5/6$ ;  $6/7$  and  $7/8$  are missing;  $8/9$  and  $9/10$  and  $10/11$  are much thickened and displaced posteriorly together;  $11/12$  is represented only by the thin connective tissue which forms the wall of the median testicular chamber. The remaining septa are thin and attached normally.

The gizzard is subspherical. There are calciferous glands in the wall of the alimentary canal in *xii*. The intestine begins in *xv*.

There are large tufted masses of nephridia adherent to the parietes in *iii*.

Posterior to the gizzard are seven pairs of commissures, two pairs under  $8/9$ , one pair in the median testicular chamber, and one pair in each of segments *ix*, *x*, *xii*, and *xiii*.

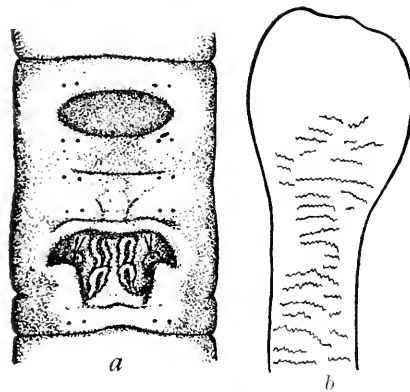


FIGURE 20.—EUTYPHOEUS PLANATUS. *a*. GENITAL AREA. *b*. TIP OF PENIAL SETA  $\times$  ABOUT 412

The testes and the male funnels are enclosed in a median chamber on the posterior face of  $10/11$ . The seminal vesicles are large, in contact dorsally, and extend from  $10/11$  to  $12/13$ , pushing  $12/13$  and  $13/14$  into contact with  $14/15$ . The tubular prostates extend through segments *xvii*–*xx*. The duct is confined to *xvii* and is looped several times.

The ovaries and oviduct funnels are in the usual positions in *xiii*. The spermathecal ampulla is large and flattened out by the gizzard, the duct is short and stout; a club-shaped diverticulum of three seminal chambers is attached to the right and to the left sides of the duct.

*Distribution.*—Prome, Thayetmyo.

*Remarks.*—The type-specimen is probably not a complete worm. The posterior opening of the alimentary canal is not a normal anus and the length of the worm is not as great as is usual in similar



species of this genus. The tail portion of the worm was doubtless amputated some time prior to the time of collecting and the broken end was healed over without producing new segments to replace the lost ones. Shorter fragments of the same species are the only other specimens included in the present collections.

The first dorsal pore is in 11/12. The clitellum begins just posterior to the setae of xii, at 12/13, or just anterior to the setae of xiii.

Setal interval *aa* varies from one and one-half to two times *bc*.

One specimen has a small oval marking on xiv in *aa* just behind the setae. Another specimen has a large oval marking on xii in *bb*, just behind the setae.

The prostatic duct is 7 to 8 mm. long.

The penial setae are 3 mm., or less in length, 48–50 micra thick across the tip, 25–28 micra thick at the narrowest point just behind the tip, and about 40 micra thick at the inner end. The tip of the seta is flattened out into a wide spatulalike structure. The ornamentation begins on the flattened portion, extends along the shaft for about 0.3–0.4 mm., and consists of numerous irregular and broken ridges of jagged teeth.

#### EUTYPHOEUS SIMILIS, new species

*Description of the type-specimen, external characteristics* (Gates collection).—Length, 177 mm. Diameter, 4–7 mm. Number of segments, 229. Color: Unpigmented, light greyish white, except on the clitellum, which is reddish brown.

The prostomium is prolobous.

On segments iv–xii, inclusive, there is a deep secondary furrow posterior to the setae. On segments vi–xii there is a deep secondary furrow anterior to the setae. On segments xi and xii there is a slight tertiary furrow on the anterior and the posterior thirds of the segment. On segment xiii there are two slight furrows anterior to the setae.

The first dorsal pore is in 11/12. Pores are also present in 12/13, 17/18, and posteriorly.

The setae are eight per segment and begin on ii. Just posterior to the clitellum *ab* is less than *cd*, *cd* is less than *bc*, and *aa* is larger than *bc*, *dd* is greater than one-half of the circumference. More posteriorly *bc* and *cd* decrease in size and become nearly equal.

The clitellum begins anterior to the setae of xiii and extends to just behind the setae of xvii. Intersegmental furrows and dorsal pores are lacking.

The male pores are conspicuous transverse slits on xvii. The center of each pore is in line with seta *b*. Two reddish setae project from each pore.

The female apertures are small diagonal slits on xiv, anterior to the setae and just internal to line *a*, on a whitish oval area.

The spermathecal pores are in line with seta *b*, in 7/8.

The genital markings are paired round papillae on xvi and xvii. The papillae of xvi are nearly twice the size of those on xvii. The anterior pair extend from internal to *a* to halfway between *b* and *c*. The posterior pair extend from just internal to *b* to halfway between *b* and *c*. At the center of each papilla is the transverse slit-shaped male aperture.

*Internal anatomy.*—Septa 4/5 and 5/6 are thickened, 5/6 about twice as much as 4/5; 8/9 and 9/10 are thickened; 10/11 is slightly thickened; 11/12 is attached normally only to the ventral parietes; 6/7 and 7/8 are absent. Segment xi is reduced to a median testicular chamber by the fusion of 11/12 to 10/11 laterally and dorsally.

The gizzard is subspherical. Calciferous glands are embedded in the wall of the alimentary canal in xii. The intestine begins in xv. There is a pair of small caeca at the sides of the intestine in xxviii.

There are tufted masses of nephridia adherent to the parietes in the region of segment iii.

There are three pairs of commissures in the combination gizzard segment, the dorsal blood vessel ending with the anteriormost pair. The last pair of hearts is in xiii.

The testes and the male funnels are inclosed within the median chamber on the posterior face of 10/11. The seminal vesicles are large, in contact with 10/11 anteriorly, and posteriorly pushing 12/13 and 13/14 back into contact with 14/15. The tubular prostates extend through xvii and xviii and are broken into two coiled masses by 17/18. The duct is about 3 mm. long and coiled twice. The vasa deferentia are enlarged as they pass into the parietes just behind the prostatic duct.

The ovaries and oviduct funnels are in the usual positions in segment xiii. The spermathecal ampulla is large and ovoid. The duct is short and practically confined to the body wall. The diverticula are short whitish projections from the right and from the left sides of the duct.

*Distribution.*—Kyundo, Kawkareik.

*Remarks.*—Aside from the type-specimen only anterior fragments of this worm are available for study. These vary in diameter from 5–7 mm. The first dorsal pore is 11/12 in all specimens.

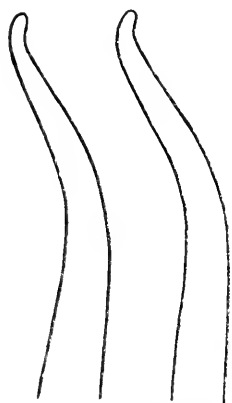


FIGURE 21.—EUTYPHOEUS  
SIMILIS. TIPS OF PENIAL  
SETAE

All the fragments have the paired papillae on xvi and xvii. One worm has a larger papilla on the right side of xxi, pushing 20/21 and 21/22 anteriorly and posteriorly, and extending from internal to *a* nearly to *c*. Another worm has a similar area in the same position on each side of xxi.

The supra-intestinal glands are 10 pairs in 5 successive segments, 85–95 mm. from the anterior end.

The penial setae are 1.8–2.4 mm. long, 50–55 micra thick at the widest region near the base. The shaft is straight except for two slight bends near the free end. The ornamentation consists of irregularly placed, finely jagged ridges which are shorter and sparsely distributed near the tip, longer and closer together toward the base.

The worm just described is very similar in general external appearance as well as internal structure to *E. peguanus*. Some two score



FIGURE 22.—EUTYPHOEUS SIMILIS SPERMATHECAL DIVERTICULA X ABOUT 14

specimens of the latter species, from the type-locality, Rangoon, have been available for comparison with the Kyundo form. The differences between the two forms may be summarized as follows:



FIGURE 23.—EUTYPHOEUS PEGUANUS. SPERMATHECAL DIVERTICULA X ABOUT 14

|                                | <i>E. peguanus</i>  | <i>E. similis</i>  |
|--------------------------------|---|--|
| Male pores.....                | In <i>bc</i> close to <i>b</i> . On the posterior third of longitudinally placed oval papillae. | In line with <i>b</i> . On the center of round papillae. |
| Spermathecal pores.....        | In <i>bc</i> , to <i>c</i> .....  | In <i>b</i> .  |
| Clitellar genital markings.... | Paired, on xvii only.*.....   | Paired, on xvi and xvii.                                 |
| Extra clitellar markings.....  | Paired, on xix.....   | Paired, on xxi.  |
| Male funnels.....              | In x and xi (not hitherto recorded from x in this species).                                     | In xi only.  |
| Prostatic duct.....            | 7–8 mm. long.....   | 2–3 mm. long.  |
| Penial setae:                  |   |  |
| Length.....                    | 1.3–1.8 mm.....   | 1.8–2.4 mm.  |
| Basal thickness.....           | 35–50 micra.....  | 50–55 micra.   |
| Curvature.....                 | One.....  | Two.   |
| Spermathecal diverticulum....  | Usually bent.....   | Usually not bent, smaller.                               |

So far as the majority of the characteristics listed above are concerned, the two forms are sharply delimited and do not grade into each other. The curvature of the penial setae and the form of the spermathecal diverticulum do, however, vary somewhat in both forms.

The majority of the normal penial setae of *E. peguanus* are curved as illustrated, although several setae were found with a shaft

curvature resembling that figured for the other species. Similarly, diverticula were found in several specimens of *E. peguanus* that are not bent and similar to the diverticula of the other species. But the diverticula from the large majority of worms examined conform to the types figured. Both characters, that is, structure of the tip of penial setae and shape of the diverticula are similarly variable in well-defined species.

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FIGURE 24.—EUTYPHOEUS PEGUANUS. PENIAL SETA, DRAWN FROM A MICROPHOTOGRAPH

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A CONTRIBUTION TO OUR KNOWLEDGE OF THE  
ANATOMY OF THE FRESH-WATER MUSSELS OF THE  
DISTRICT OF COLUMBIA

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All of the North American fresh-water mussels are contained in the family Unionidae, of which five genera are native to the District of Columbia. These are *Lampsilis*, *Strophitus*, *Anodonta*, *Alasmidonta*, and *Elliptio*. The genus *Lampsilis* has four species native to the District of Columbia—*L. cariosus* Say, *L. ochraceus* Say, *L. radiatus* Gmelin, and *L. nasutus* Say. *Strophitus* has one local species: *S. undulatus* Say. *Anodonta* has one: *A. cataracta* Say. *Alasmidonta* has three: *A. undulata* Say, *A. heterodon* Lea, and *A. marginata* Say. *Elliptio* is represented by two local species: *E. complanatus* (Solander) Dillwyn and *E. productus* Conrad.

In the following anatomical descriptions are given the differences exhibited by five local species, namely, *Lampsilis ochraceus*, *L. nasutus*, *Anodonta cataracta*, *Elliptio complanatus*, and *E. productus*.

ANATOMY OF LAMPSILIS OCHRACEUS SAY

Plate 1, figs. 1 to 10

DESCRIPTION OF THE SHELL

Plate 1, figs. 1, 2, and 4

The shell is elliptical with full beaks which are sculptured with a few straight, stout ridges. Posteriorly from the beaks a well-developed posterior ridge begins and curving slightly down the middle of the shell ends in a blunt point halfway up the height of the shell. The outside is dull, tawny-brownish, usually smoky and feebly rayed.

The interior of the shell is pearly gray, iridescent, often growing into a deep rose along the margin of the shell.

The left valve has two small pseudocardinal teeth in front of the beak cavities and two thin, lateral hinge teeth. The right valve has two pseudocardinals opposite each other (with a pit between) and one high thin lateral.

The muscle scars of both shells are identical, forming shallow cicatrices on the interior face of the shell. The anterior adductor scar lies in front of the pseudocardinal teeth and is somewhat oval in outline. At the termination of the lower pseudocardinal tooth is the anterior retractor muscle scar which is deeper than the anterior adductor scar and continuous with it. Below the impression of these two muscles is the small circular impression of the protractor pedis muscle. At the termination of the lateral hinge tooth is the scarcely visible oval scar of the posterior adductor muscle. Directly above it is the impression of the posterior retractor muscle which is small and circular and often invisible. A very faint line runs about a quarter of an inch from the margin of the shell from the anterior to the posterior adductor muscle. It is the impression of the pallial line muscles, small muscles inserted along the margin of the mantle.

In the beak cavities there is an irregular number of very small scars, one of which is a deep elliptical scar in the apex of the cavity and is the impression of a small dorsal mantle muscle.

#### MANTLE

#### Plate 1, fig. 3

The mantle lobes are separated for almost the length of the posterior adductor muscle in the formation of the dorsal mantle aperture. They are then united for about 3 mm. before separating to form the exhalent siphon. The tentacles of the exhalent siphon are rudimentary while those of the inhalent siphon are from 1 to 2 mm. in length.

The pigmentation of the dorsal mantle aperture and of the siphon is heavy, growing fainter and disappearing as the margins continue anteriorly.

The lack of pigmentation along the entire mantle edge, exclusive of the siphons, the absence of tentacles beyond the inhalent siphon but rudimentary tentacles at the exhalent siphon and a more elongate form of body distinguish this species from *L. nasutus*.

#### MUSCULAR SYSTEM

#### Plate 1, fig. 8

The largest muscles are the anterior and the posterior adductor muscles, great cylindrical masses of fibers situated on a line with each other on the dorsal portion of the body, piercing the mantle as they traverse the body to their attachment on the valves. Their functioning keeps the valves closed.

The remaining muscles are the anterior and the posterior retractors, the protractor pedis, two small muscles inserted in the cavities of the beak, and the small muscles of the pallial line. In alcoholic specimens, the anterior retractor muscle is very small and circular in appearance, with its point of insertion just posterior to the upper



portion of the anterior adductor muscle. This muscle passes downward to the anterior ventral portion of the foot with its greatest development in the anterior portion.

The posterior retractor muscle lies on the anterior ventral portion of the posterior adductor muscle. At this point it is a compact cylinder of fibers which after a short distance spreads diagonally through the body and foot and supplies the thick musculature of the foot. These muscles are antagonistic to the protractor pedis muscle which lies just at the base of the anterior adductor muscle and presents, with the mantle intact, a crescent-shaped form. With the mantle removed, it is seen to be fan-shaped, spreading outward over a large portion of the body and foot. By its play the foot is capable of great expansion. The two small muscles with their attachments in the beak cavities serve to retain there the dorsal portion of the body. The pallial line muscles are inserted along the edge of the mantle and form a delicate connection between the mantle and shell.

The muscular system of the remaining species is the same as for *L. ochraceus*.

#### LABIAL PALPS

Plate 1, fig. 7

The labial palps surround the mouth and consist of two pairs of thin contractile flaps which are subtriangular in shape with an inner and outer palp on each side of the body. Their edges are attached dorsally and are free ventrally. The outer edge of the outer palp is attached to the mantle, with the inner edges of each palp united, and the outer edge of the inner palp attached to the body mass. Anteriorly the palps are attenuated and at their confluence directly under the anterior adductor muscle give contour to the oral orifice with the attenuated portion of the outer palp forming the upper lip and that of the inner palp forming the lower lip.

The exterior faces of the palps are smooth. The inner faces are strongly furrowed transversely for about three-quarters of the distance, where the transverse furrows terminate abruptly and longitudinal furrows begin and continue to the mouth where they curve inward and pass into the gullet. These ridges bear cilia which sweep along the food brought into the mantle cavity at the inhalent siphons. The cilia on the transverse ridges check undesirable substances and send them back into the mantle cavity, while the cilia of the longitudinal furrows sweep the desirable food into the mouth.

#### GILLS AND REPRODUCTIVE SYSTEM

Plate 1, figs. 6, 7, and 9

The noticeably semicircular form is the only peculiarity of the gills of *L. ochraceus*. The marsupium occupies the hinder portion of the outer gills.

The glochidia are hookless.

## BEAK SCULPTURE

Plate 1, fig. 5

## ALIMENTARY SYSTEM

Plate 1, fig. 9

The mouth is immediately below the anterior adductor muscle. It is oval in shape and leads by a short gullet into the stomach, which is of irregular shape, but more oval than globular, with plications on its inner surface, and lies just posterior to the anterior adductor muscle. Surrounding the stomach are the digestive glands, hepatopancreas, a brown, spongy mass made up of minute tubes in clusters whose orifices open into the stomach. The intestine is given off from the left posterior portion of the stomach and, in alcoholic specimens, is about 3 mm. in diameter. It descends obliquely through the visceral mass with a slight curve almost to the posterior margin of the foot where it curves dorsally following the line of the foot margin. It is narrowest here, about 1 mm. in diameter. At a point midway between the dorsal and ventral portions of the body mass the curve proceeds anteriorly and continues in an oblique line until at a point below the anterior portion of the renal organ it turns to the right and then backward, still following the curve of the foot, and continues anteriorly for about two-thirds of the length of the body where it is attached to the visceral mass. Turning again to the right side of the body, it continues dorsally and posteriorly, keeping to the right of the portion descending from the stomach. It continues anteriorly for a short distance where it again turns and passing upward becomes very broad—about 5 mm. in diameter. From this point the wall is produced into a fold (typhlosole) continuing through the rectum. Approaching the dorsal surface in an oblique line it grows gradually smaller until it turns abruptly backward and passes into the pericardium; leaving the visceral mass, the intestine or rectum passes through the heart over the posterior adductor muscle, and bending dorsally terminates with the anus in the suprabranchial chamber.

The labial palps and alimentary system are the same for all species.

## NERVOUS SYSTEM

Plate 1, fig. 10

Paired nerve centers or ganglia, with their emanating branches and commissural cords connecting the ganglia, form the nervous system. There are three nerve centers, an anterior, a visceral, and a posterior, supplying the respective portions of the body, which are called the cerebral ganglia, the pedal ganglia, and the posterior ganglia.

The cerebral ganglia are paired and lie bilaterally symmetrically on each side of the body in front of the protractor pedis muscle.

They are very near the surface, being exposed by removing the film of the mantle. A single ganglion is roughly triangular with the apex directed downward and a little anteriorly. From the most anterior end there is a stout cerebral commissure which passes over the gullet to connect with the ganglion of the other side. From the anterior ventral portion three large nerves arise. The most anterior one bifurcates after a short distance, one branch passing around the most anterior edge of the mantle and the other descending to the anterior portion of the mantle. Behind this nerve descends another, also bifurcating after a short distance and supplying also the anterior mantle area. The last of these three nerves, after bifurcating, divides and redivides to supply the remaining anterior portion of the mantle. At the middle anterior portion of this ganglion a nerve arises which passes to the anterior adductor muscle, supplying it with its branches. Posteriorly the ganglion narrows to pass into the posterior commissural cord which passes upward through the visceral mass into the renal organ where it runs parallel with the commissural cord of the opposite ganglion. After leaving the renal organ the two commissures spread out to pass around the tendons of the posterior retractor muscle, after which for a short distance they run close together and pass into the posterior ganglion. From the inward central portion of the cerebral ganglia the pedal commissural cord arises at right angles, then turns abruptly down, passes through the protractor pedis muscle, and descends deep into the center of the foot to meet the pedal ganglion. On the dorsal portion of the cerebral ganglion are two very small nerves which supply the protractor pedis and the anterior retractor muscle. The labial palps receive a filamentous nerve supply from a branch of the anterior mantle nerve.

The pedal ganglia lie at a slightly elevated angle deep in the ventral part of the visceral mass near the center. They are exactly contiguous and present a bilobed appearance, though they are not fused.

At the anterior end the stout commissural cord to the cerebral ganglion arises. From the posterior end two large nerves are given off. The inner, after bifurcating, traverses the whole length of the body mass. The outer nerve bifurcates, sending its branches, which also fork, to the muscles of the foot. On the outer edge of the ganglion two forking nerves arise and continue to the musculature of the foot. From the inward portion of the ganglion at the center a nerve arises at right angles and supplies the viscera.

At the posterior nerve center the paired ganglia have become fused into a single bilobate mass which is situated on the ventral surface of the posterior adductor muscle. From the anterior end four nerves pass. The two inner or mesial ones are the commissural

cords which pass to the cerebral ganglia. The two outer ones pass parallel for a short distance with the commissural cords and then turning abruptly backward continue along the junction of the gills supplying them with its numerous branches. At the posterior portion a gigantic nerve arises which separates into three large branches. The central branch supplies the inhalent siphon, the inner or mesial branch the posterior portion of the mantle, and the outer branch the exhalent siphon.

The nerves emanating from the ganglion often vary with the individual mussel. A certain nerve may be entirely lacking or exceedingly large or very delicate. The most constant arrangement however, is the one given above and shows no variation for different species.

#### EXCRETORY SYSTEM

Plate 1, fig. 9

The excretory system for all five species exhibits no peculiarities.

#### CIRCULATORY SYSTEM

Plate 1, fig. 10

The circulatory system of *L. ochraceus* and of the other species included in this study shows no variation. From the ventricle proceed two aortae, one passing anteriorly and above the rectum, though almost contiguous with it; the other passing posteriorly enters the visceral mass below the rectum. They are the anterior and posterior aortae from which numerous arteries arise. The anterior aorta, on entering the visceral mass, curves outward and slightly to the right, then passes downward and a little posteriorly gives off a large artery, which passes into the mantle. The main branch continues its downward anterior course and near the center of the visceral mass divides into three large arteries which pass in and out among the folds of the intestine. Just before the curving main branch begins its downward course a large artery is given off which curves downward back of the anterior adductor muscle and curves posteriorly, to supply, with its numerous veins, the ventral portion of the body mass. From this artery, a little before it reaches the anterior adductor muscle, ascends a branch which passes into the muscle, supplies the mouth and anterior portions of the body.

The posterior aorta bifurcates just before reaching the posterior adductor muscle, sending one branch to the muscle and to the region of the pericardium and the rectum. The other branch passes over the muscle and enters the mantle, continuing ventrally to meet the anterior mantle artery. The blood supply of the mantle is continually oxygenated by the current of water which bathes the inner face of the mantle. It is, therefore, returned directly to the auricles without passing through the gills.

## ANATOMY OF LAMPSILIS NASUTUS SAY

Plate 2, figs. 1 to 10

DESCRIPTION OF THE SHELL

Plate 2, figs. 1, 2, 4

The shell is not shiny and ranges in color from dark brown to olive green; it is thin to moderately solid, elongated, and has a distinct posterior ridge, which generally is curved down the middle. The anterior ventral margin curves broadly to the base which is full behind the center, attenuating to a long point halfway up the height of the shell.

The highly characteristic beaks are low and sculptured with fine close ridges, looped in front and following the paralleling longitudinal axis of the shell behind. (Pl. 2, fig. 5.) The exterior surface shows irregular growth lines, with sometimes vertical bars just back of the center, representing the growth of the shell over the gills while distended with fry. Young shells are finely rayed, while in the adult shell the rays are less distinct or entirely invisible.

The interior of the shell is iridescent and lustrous and may be bluish-white, lurid, flesh-tinted, or purplish. The left valve has two pseudo cardinal teeth and one lateral hinge tooth, which is nearly straight and very delicate. The right valve has one pseudocardinal tooth with a faint one above it and two lateral hinge teeth. The muscle scars are shallow, the anterior adductor scar being the more prominent. It is situated dorsally near the anterior margin of the shell and is oval shaped and very clear cut. The posterior adductor scar is a large faint oval impression just below the termination of the hinge teeth. Dorsal to it is the small circular impression of the posterior retractor muscle. On the posterior ventral margin of the anterior adductor muscle scar are two small irregular impressions, one dorsal. They are the anterior retractor and the protractor pedis muscle scars, respectively. Beginning at the most ventral point of the anterior adductor muscle scar, there is a thin faint impression running parallel with the margin of the shell and about one-fourth inch distant from it and ending at the base of the posterior adductor muscle. It is the pallial line impression and marks the insertion of the small pallial line muscles. There are two small pitted scars in the beak cavities which mark the insertion of the small dorsal muscles.

## MANTLE

Plate 2, fig. 3

From the posterior adductor muscle the margins of the mantle are separated for the length of the muscle to form the dorsal mantle aperture. The edges reunite for a short distance and then separate again to form the exhalent siphon, the lower portion of which is

formed by the junction of the gills. It meets again, but is not fused, to form the upper part of the inhalent siphon and below this point is not united. The margins of both siphons are greatly thickened and pigmented, bearing on their inward surface numerous tentacles. In specimens preserved in alcohol the tentacles of the inhalent siphon have an average length of 3 mm., while the tentacles of the exhalent siphon are smaller and not so numerous. From the inhalent siphon the tentacles continue on the inward margin of the mantle to a median point, growing smaller and diminishing in number until the last several tentacles are about 5 mm. apart. The margin from this point to its junction over the anterior adductor muscle diminishes in thickness and is free from tentacles. The edge of the mantle is distinctly pigmented along its entire course. This pigmentation is very heavy at the siphons and at the posterior tentacle-bearing portion.

#### GILLS AND REPRODUCTIVE SYSTEM

Plate 2, figs. 6, 7, and 9

The gills are elongated with the inner lamellae continuous with the visceral mass anteriorly. There are about 10 gill filaments between the septa of that portion of the gills which serves as a marsupium and about 20 septa between that which does not, so that a gill or a part of one with more numerous septa than other portions is indicative of a marsupium and therefore of the female mussel. There is a very inconspicuous longitudinal furrow passing around the base of the inner gills and is caused by a very slight invagination of the gill filaments. The inner or mesial gills have no such groove, for the filaments are smoothly curved as they bend upon themselves at the base. This furrow is present in the gills of both sexes. In *L. nasutus* the gravid gill protrudes much beyond the original base of the filaments. This condition is readily seen by the projection of the bulging gills beyond the chitinous rods of the filaments which have a clear-cut line of termination. This projection beyond the filaments is not uniform, for the septa are continuous with the stretched area, checking at their points of insertion the bulging, and therefore giving a scalloped or beaded appearance to the edge of the gill.

In *L. nasutus* the posterior portion of the outer gills is specialized to form the marsupium.

The glochidia are of the hookless type.

#### BEAK SCULPTURE

Plate 2, fig. 5

#### ANODONTA CATARACTA Say

Plate 3, figs. 1 to 10

In the genus *Anodonta* the male and female shells are alike, the beak sculpture is coarse and the embryos fill the entire gills, forming

smooth pads. The inner lamellae of the inner gills are free from the visceral mass. Hinge teeth are absent and the muscle scars faint. The shell is rather thin, evenly rounded in front and somewhat biangulate behind and is very slightly winged in the postero-dorsal region. The beaks are rather full, the sculpture consisting of a moderate number of concentric ridges which are usually doubly looped. The surface is usually covered with irregular growth lines. The exterior is generally shining, greenish-yellow, yellow-green or olive, usually banded with darker color and often faintly rayed. The interior is bluish-white and not shining. There are no small, dorsal muscles in *Anodonta*.

## MANTLE

## Plate 3, fig. 3

The mantle edge is strongly pigmented at the siphons. The connection of the mantle edge runs nearly the length of the posterior adductor muscle, restricting the dorsal mantle aperture to a very short slit and causing it to lie behind the anterior adductor muscle. The tentacles of the inhalent siphon are large with some of them forking. The exhalent siphon has no tentacles.

## GILLS AND REPRODUCTIVE SYSTEM

## Plate 3, figs. 6, 7, and 9

The gills are semicircular with the inner lamellae of the inner gills free from the visceral mass. The entire outer gill serves as a marsupium. During the breeding season the water tubes of the marsupium are divided longitudinally into three tubes with the two outer tubes facing the inner and outer lamina. It is only the central tube which contains embryos. This threefold division of the water tubes is present only during the breeding season.

The glochidia of *A. cataracta* are of the hooked type.

## BEAK SCULPTURE

## Plate 3, fig. 5

*Elliptio productus* Conrad and *Elliptio complanatus* (Solander) Dillwyn.

In this genus three species of the *fisherianus* group, *Elliptio productus*, *E. fisherianus*, and *E. lanceolatus* have been thought to occur in the District of Columbia. Close examination of both shell and morphology shows that there is no constant distinction, and it is therefore thought that the only representative of this, the *fisherianus* group, in the District of Columbia is *E. productus* Conrad.

The group of *fisherianus* is distinctive in the manner of gill attachment, for the outer lamina of the inner gill, instead of having the usual connection to the visceral mass, is free.

**ELLIPTIO COMPLANATUS**

Plate 4, figs. 1 to 10

## SHELL

Plate 4, figs. 1, 2, and 4

The shell of *Elliptio complanatus* has an elongate trapezoidal shape, with the dorsal and ventral margins nearly parallel. The posterior ridge which is well developed and generally double, ends in a point at the base, while the anterior end is rounded.

The surface of the shell is marked by irregular growth lines which are smooth in the young shell and rough in the old. In color it ranges from tawny green to greenish brown.

In *E. complanatus* there is no marsupial bulge distinguishing the female shell. The interior may be white, straw-color, salmon, or various shades of purple.

In the left valve there are two nearly straight lateral hinge teeth and two irregular pseudocardinals, while in the right valve there is one lateral hinge tooth and one stumpy pseudocardinal with a faint one above it.

From the base of the anterior adductor scar just in front of the pallial line impression, there is a delicate groove which passes downward and curves around the base of the shell representing the course of the mantle artery.

## MANTLE

Plate 4, fig. 3

The only variation in the mantle is a heavier pigmentation at the siphons. The anterior and posterior adductor muscles are very large with the anterior muscle assuming a distinct quadrilateral shape. The body is roughly trapezoidal in shape.

## GILLS AND REPRODUCTIVE SYSTEM

Plate 4, figs. 7, and 9

The gills are semicircular with the marsupium occupying the entire outer gills.

The glochidia are hookless.

## BEAK SCULPTURE

Plate 4, fig. 5

**ELLIPTIO PRODUCTUS**

Plate 5, figs. 1 to 10

## SHELL

Plate 5, figs. 1, 2, and 4

The shell is elongated, ranging in color from dark reddish brown to olive green and is rather thin. The beaks, which in the adult shell are generally eroded, are low. In very young shells there is a



definite beak sculpture so characteristic that it is a reliable means of classification. In *E. productus* the beak sculpture consists of strong, longitudinal, corrugated ridges.

The posterior ridge is well developed, curved down the middle, ending behind the center in a long, drawn-out point near the median line with the point often turned up. From the beaks in a radial direction are heavy, irregular growth lines.

The interior of the shell is iridescent and is purplish or whitish and shows muscular scars. In the left valve on the dorsal surface are two stumpy pseudocardinal teeth and two strong lateral hinge teeth. In the right valve is one pseudocardinal and one lateral tooth.

## MANTLE

## Plate 5, fig. 3

The mantle edge at the dorsal mantle aperture and the siphons is pigmented, but not heavily so. The dorsal mantle aperture extends almost the length of the posterior adductor muscle, while the connected portion between this aperture and the exhalent siphon is about as long as the inhalent siphon. Both siphons bear tentacles. The body is slender and elongate.

## GILLS AND REPRODUCTIVE SYSTEM

## Plate 5, figs. 6, 7, and 9

The gills are very much elongated, with the outer pair serving as a marsupium and forming a smooth pad when filled with embryos.

The glochidia are hookless.

## BEAK SCULPTURE

## Plate 5, fig. 5

## EXPLANATION OF PLATES

## FIGURE 1

- |                   |                    |
|-------------------|--------------------|
| 1. Hinge line.    | 5. Anterior end.   |
| 2. Beaks.         | 6. Posterior end.  |
| 3. Growth lines.  | 7. Ventral margin. |
| 4. Dorsal margin. |                    |

## FIGURE 2

- |                                     |                                    |
|-------------------------------------|------------------------------------|
| 1. Lateral hinge teeth.             | 5. Anterior retractor muscle scar. |
| 2. Posterior retractor muscle scar. | 6. Anterior adductor muscle scar.  |
| 3. Posterior adductor muscle scar.  | 7. Protractor pedis muscle scar.   |
| 4. Pseudocardinal tooth.            | 8. Pallial line muscles scar.      |

## FIGURE 3

- |                               |                                 |
|-------------------------------|---------------------------------|
| 1. Anterior retractor muscle. | 9. Renal organ.                 |
| 2. Anterior adductor muscle.  | 10. Posterior retractor muscle. |
| 3. Protractor pedis muscle.   | 11. Dorsal mantle aperture.     |
| 4. Pallial line muscles.      | 12. Posterior adductor muscle.  |
| 5. Foot.                      | 13. Exhalent siphon.            |
| 6. Pericardial gland.         | 14. Inhalent siphon.            |
| 7. Ventricle.                 | 15. Dorsal mantle muscles.      |
| 8. Left auricle.              |                                 |

## FIGURE 4

- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1. Pseudocardinal teeth.           | 5. Pallial line muscles scar.       |
| 2. Anterior retractor muscle scar. | 6. Lateral hinge tooth.             |
| 3. Anterior adductor muscle scar.  | 7. Posterior retractor muscle scar. |
| 4. Protractor pedis muscle scar.   | 8. Posterior adductor muscle scar.  |

## FIGURE 5

Beak sculpture, enlarged.

## FIGURE 6

- |                            |                           |
|----------------------------|---------------------------|
| 1. Cross section of shell. | 2-3. Glochidia, enlarged. |
|----------------------------|---------------------------|

## FIGURE 7

- |                      |                       |
|----------------------|-----------------------|
| 1. Left mantle lobe. | 5. Marsupium.         |
| 2. Labial palps.     | 6. Inner gill.        |
| 3. Foot.             | 7. Right mantle lobe. |
| 4. Outer gill.       |                       |

## FIGURE 8

- |                                |                               |
|--------------------------------|-------------------------------|
| 1. Anterior retractor muscle.  | 5. Posterior adductor muscle. |
| 2. Anterior adductor muscle.   | 6. Pallial line muscles.      |
| 3. Protractor pedis muscle.    | 7. Dorsal mantle muscles.     |
| 4. Posterior retractor muscle. |                               |

## FIGURE 9

- |                     |                                |
|---------------------|--------------------------------|
| 1. Mouth.           | 9. Renal aperture.             |
| 2. Stomach.         | 10. Reno-pericardial aperture. |
| 3. Intestines.      | 11. Ventricle.                 |
| 4. Typhlosole.      | 12. Left auricle.              |
| 5. Rectum.          | 13. Urinary bladder.           |
| 6. Anus.            | 14. Kidney.                    |
| 7. Hepato-pancreas. | 15. Pericardium.               |
| 8. Gonads.          |                                |

## FIGURE 10

- |                                     |                                       |
|-------------------------------------|---------------------------------------|
| 1. Cerebral ganglia.                | 15. Gill nerves.                      |
| 2. Anterior adductor muscle nerves. | 16. Exhalent siphon nerves.           |
| 3. Cerebral commissure.             | 17. Inhalent siphon nerves.           |
| 4. Anterior mantle nerves.          | 18. Ventricle.                        |
| 5. Pedal commissure.                | 19. Left auricle.                     |
| 6. Pedal ganglion.                  | 20. Anterior aorta.                   |
| 7. Anterior visceral nerves.        | 21. Anterior adductor muscle artery.  |
| 8. Anterior visceral nerves.        | 22. Pedal artery.                     |
| 9. Visceral nerves.                 | 23. Visceral artery.                  |
| 10. Posterior visceral nerves.      | 24. Posterior aorta.                  |
| 11. Posterior visceral nerves.      | 25. Posterior mantle artery.          |
| 12. Posterior commissure.           | 26. Posterior adductor muscle artery. |
| 13. Posterior ganglion.             | 27. Anterior mantle artery.           |
| 14. Posterior mantle nerves.        |                                       |

## PLATE 1

*Lampsilis ochraceus* Say.

## PLATE 2

*Lampsilis nasutus* Say.

## PLATE 3

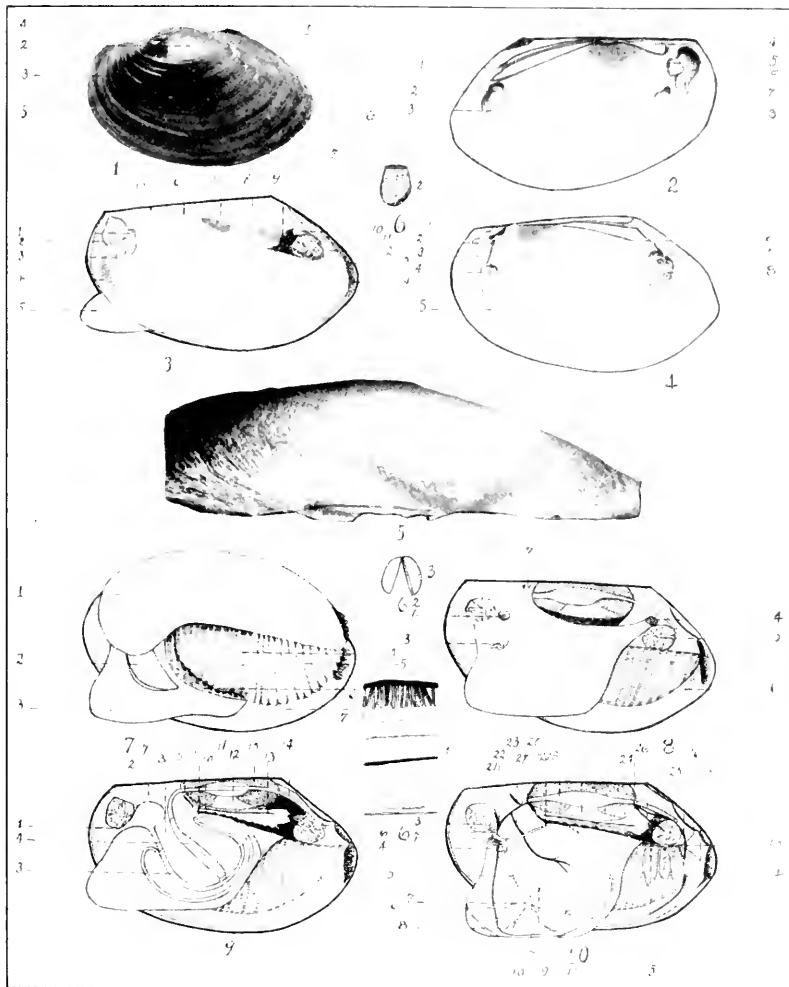
*Anodonta cataracta* Say.

## PLATE 4

*Elliptio complanatus* (Solander) Dillwyn.

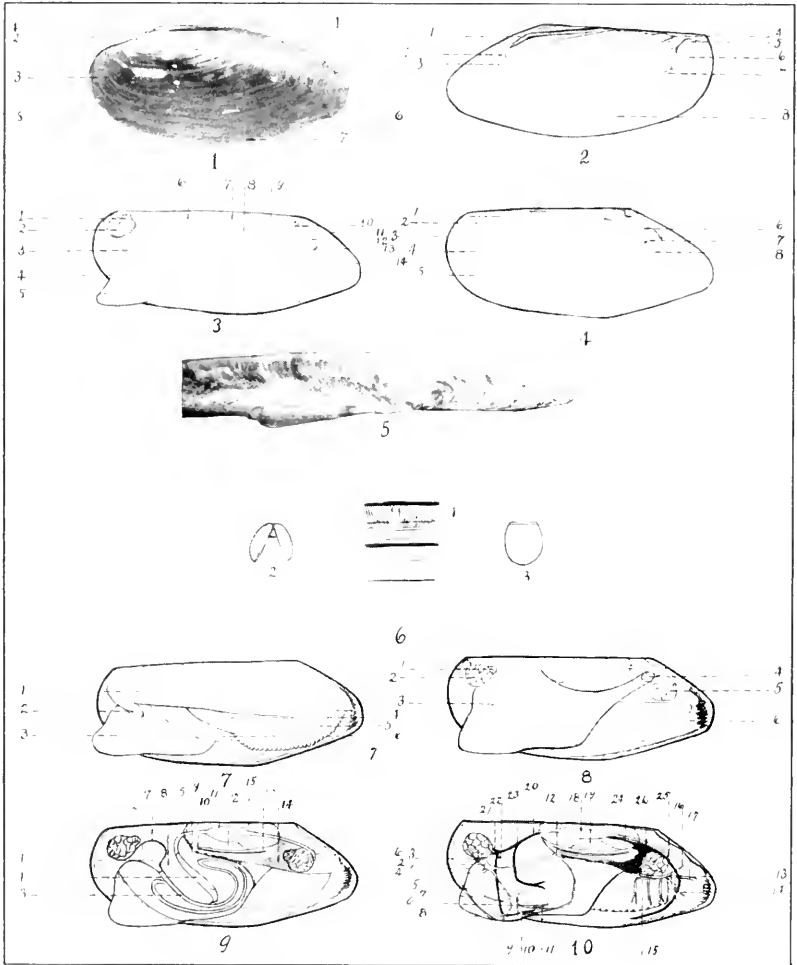
## PLATE 5

*Elliptio productus* Conrad.



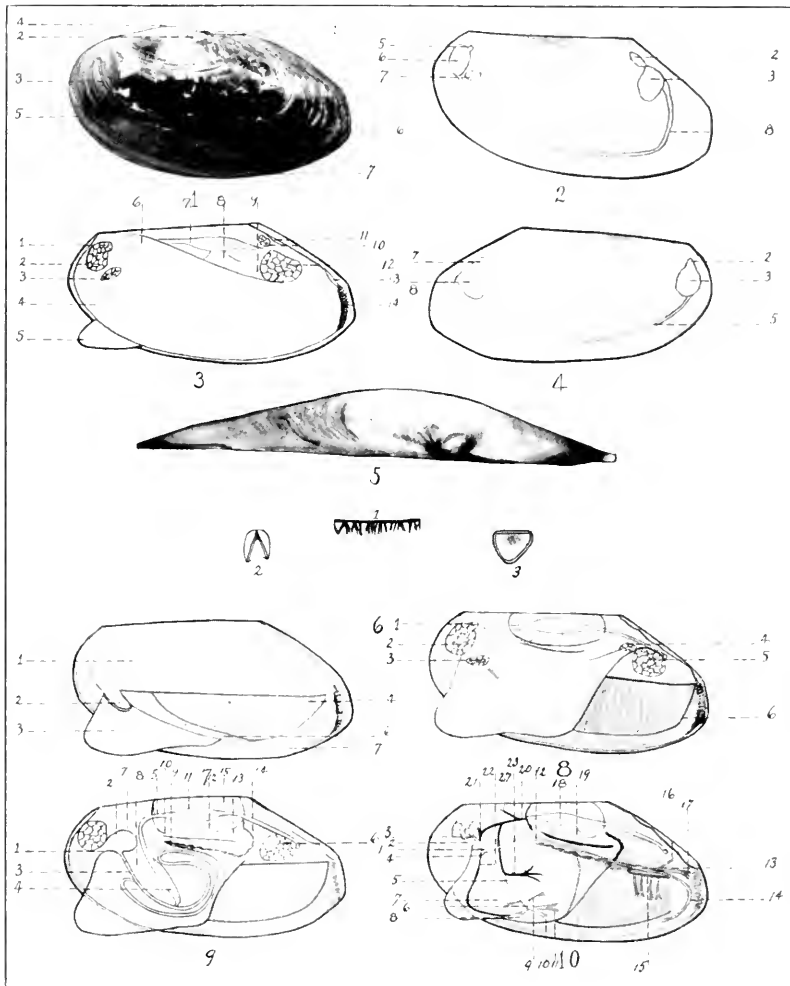
LAMPILIS OCHRACEUS SAY

FOR EXPLANATION OF PLATE SEE PAGE 12



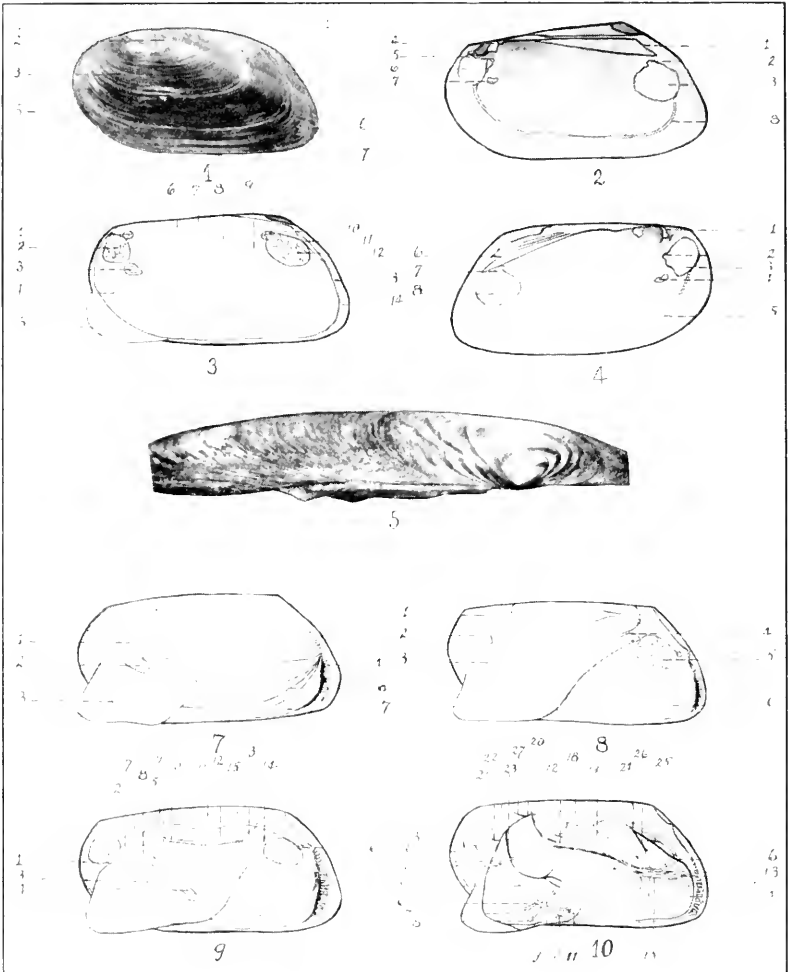
LAMPSILIS NASUTUS SAY

FOR EXPLANATION OF PLATE SEE PAGE 12



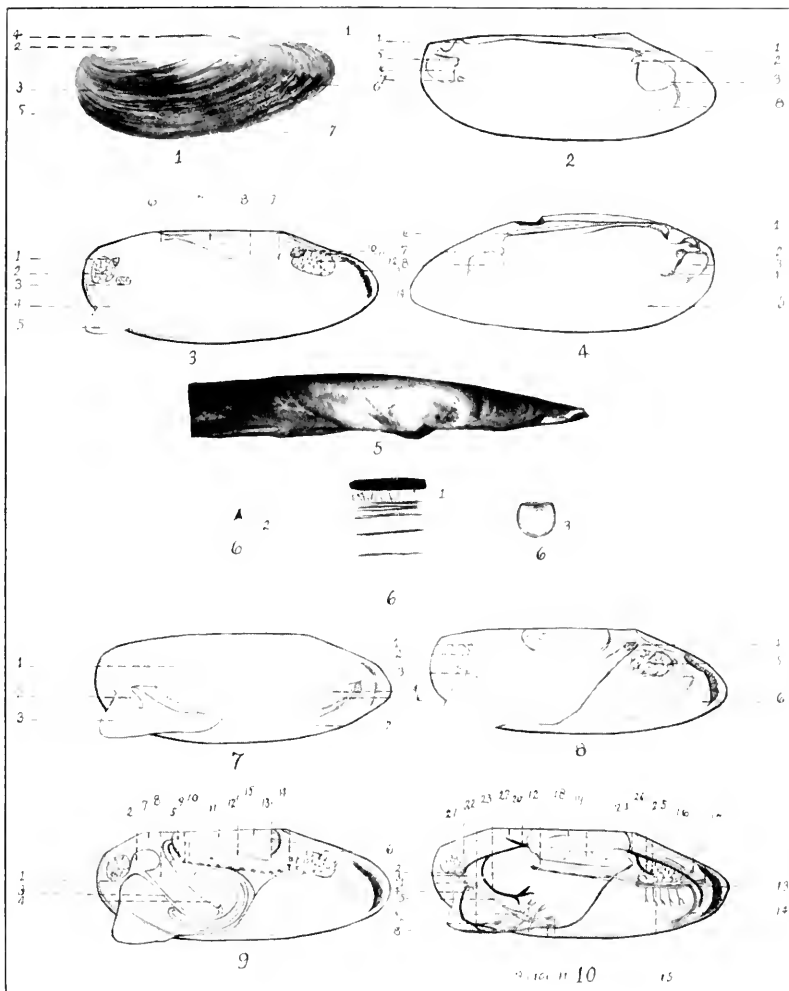
ANODONTA CATARACTA SAY

FOR EXPLANATION OF PLATE SEE PAGE 12



ELLIPTIO COMPLANATUS (SOLANDER) DILLWYN

FOR EXPLANATION OF PLATE SEE PAGE 12



ELLIPTIO PRODUCTUS CONRAD

FOR EXPLANATION OF PLATE SEE PAGE 12





# A NEW LIVER FLUKE FROM A MONKEY AND NEW PARASITIC ROUNDWORMS FROM VARIOUS AFRICAN ANIMALS

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The Harvard African Expedition of 1926-27, under the leadership of Prof. Richard P. Strong of the department of tropical medicine, Harvard University Medical School, spent some months in the Republic of Liberia and then crossed Africa from the Belgian Congo on the west to Mombassa on the east coast, making investigations of the natives and the local fauna from the medical and zoological aspects.

In the extensive collection of material brought back to the United States for detailed study are many tubes of parasites from various animals secured in the different localities where halts were made. Many of these parasites were assigned to me for identification and systematic study, and I take pleasure in recording my indebtedness to Professor Strong for this privilege.

The following paper, constituting part of the report on the parasite collection, contains a description of a new species of the trematode genus *Dicrocoelium* from the liver of a monkey, a new genus of the nematode family Strongylidae, also from a monkey, and a new species of the trichostrongylid genus *Oswaldocruzia* from a lizard. *Nematodirus hopkeni* (Leiper 1907) from the hippopotamus was well represented in this collection, and as a result of the reexamination of this parasite it is considered necessary to remove it from the genus *Nematodirus* and to create a new genus for its reception.

Several other helminths, probably new to science, are also present in this collection, but the inadequacy or the unfavorable condition of some of the material does not permit me to give a complete description and specific determinations of these worms at the present time.

As a matter of record, a list is appended of parasites present in the collection which could be identified generically, and in some instances specifically, with the material available.

An asterisk denotes a new host record of a previously described species of parasite.

## TREMATODA

| Parasite  | Host                            | Locality                       |
|---|---------------------------------|--------------------------------|
| <i>Fasciola hepatica</i> Linnaeus, 1758.                                      | <i>Bubalus caffer</i> .....     | Ituri Forest, Belgian Congo.   |
| CESTODA   |                                 |                                |
| <i>Anaplocephala gorillae</i> Nybelin, 1927.                                  | <i>Gorilla beringei</i> .....   | Lake Kivu, Belgian Congo.      |
| <i>Bothridium ovatum</i> Diesing, 1850.                                       | <i>Python</i> species .....     | Rutchuru River, Belgian Congo. |
| NEMATODA  |                                 |                                |
| <i>Murshidia</i> species.....   | <i>Loxodonta africana</i> ....  | Semliki Valley, Belgian Congo. |
| <i>Cobboldina vivipara</i> Leiper, 1911.                                      | <i>Hippopotamus amphibius</i>   | Lake Albert, Belgian Congo.    |
| <i>Setaria labiato-papillosa</i> (Alessandri, 1838) Railliet and Henry, 1911. | <i>Bubalus caffer</i> .....     | Ruindi Plains, Belgian Congo.  |
| <i>Setaria poultoni</i> Thwaite, 1928.  | <i>Damaliscus tiang</i> .....   | Ruindi Plains, Belgian Congo.  |
| <i>Setaria hornbyi</i> Boulenger, 1921.                                       | * <i>Cobus defassa</i> .....    | Ruindi Plains, Belgian Congo.  |
| <i>Cylicospirura subaequalis</i> Molin 1860.                                  | * <i>Felis leo</i> .....        | Rutchuru Plains.               |
| <i>Ophidascaris filaria</i> (Dujardin, 1845) Baylis, 1921                     | <i>Python</i> species.....      | Rutchuru Plains.               |
| <i>Streptopharagus pigmentatus</i> (Linst, 1897) Railliet and Henry, 1918.    | * <i>Cercopithecus diana</i> .. | Liberia.                       |
| <i>Trichuris trichiura</i> (Linnaeus, 1771) Stiles, 1901.                     | * <i>Cercopithecus diana</i> .. | Liberia.                       |
| <i>Enterobius</i> species.....  | * <i>Cercopithecus diana</i> .. | Liberia.                       |
| <i>Strongyluris brevicaudata</i> Muller, 1894.                                | <i>Agama colonorum</i> .....    | Liberia.                       |
| <i>Saurositus agamae</i> Macfie, 1924.  | <i>Agama colonorum</i> .....    | Liberia.                       |

## TREMATODA

## Family DICROCOELIDAE

The material collected from the liver of a species of *Colobus* monkey shot in the Ituri Forest, south of Lake Albert, Belgian Congo, consisted of some 15 small trematodes, which had been fixed in Zenker's solution. Of this number only three or four are not contracted and generally distorted to the extent that the structure of the parasites can not be profitably studied. The measurements given in the following description were taken from the most favorable specimens available mounted in gum damar after staining in carmine.

## DICROCOELIUM COLOBUSICOLA, new species

*Specific diagnosis.*—*Dicrocoelium*: Length 3.6 mm. to 5.2 mm. The greatest width in the largest specimen is 1.9 mm. at a post-equatorial point level with the posterior border of the yolk glands.

The body is thin and flat with weakly developed musculature. The specimen least contracted, and hence chosen to represent the type, is spindle-shaped, the body tapering gradually to a rounded extremity anteriorly. In other specimens the preacetabular region is drawn out into a rather narrow neck. The superficial cuticle is devoid of scales, but the presence of numerous subcuticular cells gives it a granular appearance which to some extent masks the internal structure so that the more delicate details are difficult to determine. Oral sucker circular in outline, from 0.22 mm. to 0.28 mm. in diameter. It is terminal and ventral, with strong muscular rim nearly  $90\mu$  wide. The oral aperture is subterminal and semilunar in shape. Muscular pharynx, 0.08 to 0.12 mm. in length, followed by a narrow esophageal region, about 0.15 mm. long, which bifurcates to form the intestinal ceca. Intestinal ceca simple, thin-walled, and so narrow that in some specimens their presence is determined with difficulty. In other specimens the ceca are about 0.12 mm. wide and run a slightly undulating course posteriorly on either side of the acetabulum to terminate in a small vesicle, just behind the middle of the body. The course of the intestinal ceca is usually entirely external to the vitellarian fields, but in some specimens the crest of the undulations overlie the vitelline glands. The acetabulum is muscular. In diameter it ranges from 0.20 to 0.28 mm., being slightly smaller in size than the oral sucker. The excretory vessel is a simple narrow tube, the lateral horns of which are not visible in mounted specimens. It opens at the posterior extremity of the body into a slight indentation of the contour of the body.

*Male genitalia.*—The testes are situated in the second quarter of the body. In the convenient terminology used by Stiles and Goldberger (1910) to describe the topography of the organs of trematodes, both the zones and fields of the two testes would be said to overlap, and the testes abut on their internal borders. In the type specimen the testes are deeply lobed and the area of the anterior testis is perhaps a little smaller than that of the posterior. In other specimens a lobed condition of the testes is not noted. The vasa-efferentia and the vas deferens are presumably too delicate to be observed in toto-mounts, but a well-developed, although small cirrus, which is somewhat coiled, can be seen. The genital atrium, which receives the cirrus, is situated just posterior to the point of bifurcation of the esophagus.

*Female genitalia.*—The ovary, measuring about 0.22 mm. by 0.28 mm., occupies a position immediately behind the right testis. It is usually ovoid in shape, sometimes almost spherical. A large receptaculum seminis, about 0.13 mm. in diameter, lies posterior to and in the same longitudinal field as the ovary. Neither Mehlis's gland nor Laurer's canal was observed. The coils of the massive

uterus are so massed together that the usual ascending and descending branches are not distinguishable. The transverse coils of the uterus occasionally extend almost to the margin of the body. The vitellaria consist of large aggregations of glands connected by rather narrow longitudinal ducts forming a moniliform band, which stretches on each side from a point just posterior to the vesicula seminalis to about the equator of the body. The transverse vitelline ducts were not conspicuous. The eggs in the posterior coils of the uterus are of a golden yellow color, but become darker as they advance toward the metraterm. In this part of the uterine tube, which passes directly under the acetabulum, the eggs measure  $44\mu$  to  $48.2\mu$  in length by  $28.3\mu$  in width; they have a slight shoulder, and are operculated.

*Host*.—*Colobus* species.

*Location*.—Liver (bile ducts).

*Locality*.—Ituri Forest, Belgian Congo, May 21, 1927.

*Type*.—Cat. No. 8012, U.S.N.M., Helm. Coll.; Cat. No. 8013, U.S.N.M.

*Paratypes*.—Helm. Coll.

#### SYSTEMATIC POSITION

The species described above is a typical member of the genus *Dicrocoelium* Dujardin, 1845, the number of species of which are numerous. They are distributed in a cosmopolitan manner in reptiles, birds, and mammals, usually occupying the bile and pancreatic ducts. The course that the intestinal ceca pursue, external to the line of vitelline glands is rather unusual, but the present species shares this character, at least, with *D. hospes* Looss, 1907, found in Egyptian cattle, and with *D. macrostomum* Odhner, 1911, of *Numida ptilorhyncha* from the White Nile. The present species resembles *D. macrostomum* to a remarkable extent, the two forms being almost identical with regard to the size and disposition of the organs. The only differences that can be detected from Odhner's description of the species concerns the inconspicuousness or absence of a receptaculum seminis (not mentioned in *D. macrostomum*) and a slightly greater length of the intestinal ceca relative to the total length of the body. The former difference may be apparent rather than real, depending upon the physiological condition of the genitalia at the time of examination, and the latter difference is so small as to be of doubtful significance. It seems, however, rather unlikely that the present material coming from a monkey is identical with the flukes from a bird derived from a totally different locality. For this reason, it is proposed to credit the two points of morphological difference, noted above, with specific value. The name, *D. colobusicola*, is provisionally proposed for the material under consideration, pending the opportunity for making a comparative examination with *D. macrostomum*.

## Family TRICHOSTRONGYLIDAE

## LEIPERIATUS, new genus

*Generic diagnosis.*—Trichostrongylidae: Dorsal lobe of bursa reduced. Two spicules, with relatively massive, ridged, proximal proportions, and with flexible, filiform terminal appendages.

*Type species.*—*Leiperiatus hopkeni* (Leiper, 1910) new combination.

## LEIPERIATUS HOPKENI (Leiper, 1910), new combination

*Synonym.*—*Nematodirus hopkeni* Leiper, 1910.

*Specific diagnosis.*—*Leiperiatus*: In the preserved state the worms are of a greenish yellow color. The cuticle is finely striated transversely, and there is also a series of a dozen or more longitudinal lines extending the entire length of the body. The cuticle of the head is not inflated. The head is about  $24\mu$  wide at the extremity. The mouth cavity is surrounded by four papillae, two subdorsal and two subventral, and a pair of amphids, laterally. The amphids, which are well developed, are considerably larger than the papillae, which are minute and inconspicuous. The buccal cavity is very shallow and into it there projects a very definite, although at times obscured, cuticularised spine, about  $6.5\mu$  long, which arises from the floor of the mouth. The esophagus, of the typical trichostrongyle type, widens only slightly posteriorly. It is about one-twelfth of the body length in the male and about one-ninth of the body length in the female. The nerve ring embraces the esophagus anteriorly in the first quarter (0.28 mm. to 0.32 mm. from its anterior end), and at the same level the excretory tube opens by a fine duct on the ventral surface. Cervical papillae were not observed in the material at hand. They may be present as minute acicular points, which are stated by Leiper to project 0.4 mm. behind the nerve ring.

*Male.*—12 to 13.4 mm. long with a maximum thickness of 0.23 mm. The bursa consists of two symmetrical lateral lobes united by a small unindented lobe, dorsally. The lateral lobes are figured, seemingly over the entire internal surface, with macular markings arranged to form a delicate mosaic design, and their posterior margins are finely scalloped by the cuticular striae which are quite conspicuous in this region. The small dorsal lobe is supported by a single dorsal ray, of proportionately reduced dimensions, which bifurcates near the middle of the lobe. Each of the bifurcations terminates in two minute digits which are slightly curved and extend to the margin of the lobe. The lateral lobes are supported by six rays of which the latero-ventral and ventro-ventral, as seen in the normal condition of the bursa, appear to be closely approximated, but when the lobes are spread out it is seen that the tips of these rays are well separated. The three lateral rays are parallel; the postero-lateral is the smallest and the

medio-lateral the stoutest. The externo-dorsal ray, the basal origin of which could not be definitely determined, is very slender. A pair of exceedingly minute prebursal papillae are also present.

The spicules are equal in size, about 0.31 mm. in length, and brown in color. Each is composed of a proximal and terminal portion. The proximal portion, about 0.18 mm. long and 0.025 mm. broad, is adorned with one or two, somewhat twisted, longitudinal crests or ridges, and appears to be tubular in form. The distal portion is filiform and flexible, often being bent, as Leiper described, in the form of an interrogation mark. The tips of the spicules are not united by a membrane. The genital cone lies ventral and just anterior to the dorsal lobe of the bursa. It is ornamented with tuberclelike papillae, but details of this structure could not be seen in the material available.

*Female*.—18 to 22.0 mm. long with a maximum diameter of about 0.30 mm. near the middle. The terminal part of the intestine is narrowed to form the rectum with cuticularized lumen which opens at a point where the body is 0.12 mm. wide, about 0.37 mm. from the posterior extremity. The body narrows gradually to form a conical tail. The vulva is without salient lips and, in a specimen 19.3 mm. long, is situated 45 mm. from the posterior extremity. The long uteri open through divergent muscular ovejectors into a short vagina. The eggs are ellipsoidal and have thin shells which measure from  $66\mu$  to  $73\mu$  long by  $40\mu$  wide.

*Host*.—*Hippopotamus amphibius*.

*Location*.—Stomach (?).

*Locality*.—Lake Albert, Central Africa, April 17, 1927.

*Specimens*.—Males and females, Cat. No. 8014, U.S.N.M., Helm. Coll.

The above description is based upon material collected and preserved separately from two hippopotami. The parasites, of which about 20 worms were collected from each animal, appear to be identical, but the material in one tube only was in reasonably good condition for study; because of the fixation the material from the second animal could not be cleared to show the internal anatomy. The species was first recorded and briefly described by Leiper (1910), who collected it from a hippopotamus shot in the Uganda and named it *Nematodirus hopkeni*. Leiper's description is unfortunately incomplete, and the diagrams accompanying the description are not accurate enough in certain details to be of service for the identification of the parasite. The shape of the spicules, however, is so distinctive that although the range of the present material is slightly larger than shown by Leiper's figures, there can be little, if any, doubt that we are concerned with the same species. Leiper described the bursa of the male as being devoid of a posterior or

dorsal lobe and its supporting dorsal ray. This discrepancy from the present description can be accounted for by the fact that this organ, although it must be constantly present, is inconspicuous. It was only exposed and visible in two of the four male specimens examined. In preparing the description presented above, a number of significant points of divergence were found distinguishing the species from the 12 or more species of the genus *Nematodirus*, and calling for a reconsideration of the taxonomic status of the worms. One of the most outstanding differences concerns the spicules, which in their filiform shape and membranous union are a constant feature of all other species of *Nematodirus*. The inclusion of "*N. hopkeni*" in the genus breaks the natural homogeneity of the spicule character and, particularly if other significant morphological differences could be found to support the action, it would be advisable to remove the species *N. hopkeni* from the genus *Nematodirus*. A comparison of "*N. hopkeni*" with other described species of *Nematodirus* provides the following additional points of departure:

|                                   | " <i>N. hopkeni</i> "               | Other species of <i>Nematodirus</i>            |
|-----------------------------------|-------------------------------------|--|
| 1. Cuticle of head.....           | Not inflated.....                   | Inflated.                                      |
| 2. Position of excretory pore.... | At level of nerve ring.             | Opposite extremity of esophagus.               |
| 3. Size of eggs.....              | 73 $\mu$ by 40 $\mu$ .....          | 95 $\mu$ to 230 $\mu$ by 70 $\mu$ to 110 $\mu$ |
| 4. Shape of tail in female.....   | Conoid.....                         | Truncated, with terminal spikelike process.    |
| 5. Dorsal lobe of bursa.....      | Very reduced and simple in outline. | Larger with indented margin.                   |

These differences are of greater than specific magnitude and warrant the removal of "*N. hopkeni*" from the genus *Nematodirus*. I propose creating for its reception the new generic name *Leiperiatus* in honor of the original describer of the parasite.

### Family TRICHOSTRONGYLIDAE

#### OSWALDOCRUZIA AGAMAE, new species

*Specific diagnosis.*—*Oswaldocruzia*.

*Male.*—Length 7.4 mm.; greatest breadth 0.15 mm. near middle of body from which point there is a gradual tapering toward the anterior end, where the body is 0.03 mm. wide. The head is rounded and bears 4 inconspicuous oral papillae and 2 amphids. The cephalic cuticle is inflated for a distance of about 35 $\mu$ . The only occurrence of striae on the cuticle is for a short distance behind the cephalic inflation, the cephalic cuticle itself being as devoid of striae as the remainder of the body. The esophagus is 0.34 mm. long, claviform, and encircled by the nerve ring, slightly anterior to its middle. A

minute cervical papilla is found opposite the nerve ring. The excretory pore is situated just anterior to the base of the esophagus.

The bursa is slightly longer than broad, and its comparatively narrow supporting rays, as indicated in the accompanying diagram, are according to the plan characteristic of the genus. A small dorsal lobe is easily distinguishable. The dorsal ray bifurcates near its end, and each branch is split into three rather minute digitations. The spicules are of a light yellow color. They measure about 0.175 mm. in length, and at their broadest point, near the anterior end, measure  $17\mu$  wide. They are very slightly ridged, not spirally fluted, and their termini are adorned with a few inconspicuous processes. Gubernaculum absent.

*Female*.—Length from 11.5 to 12 mm.; greatest breadth 0.19 mm. The esophagus is 0.55 mm. long and the cephalic inflation measures about 0.05 mm. in length. The vulva is situated 7 mm. from the anterior end, dividing the body in the ratio of 3:2. The uteri are divergent, and the anterior ovary extends forward almost to the level of the base of the esophagus where it is reflected backward. The eggs, which become embryonated before oviposition, measure on the average  $86\mu$  by  $45\mu$ . The body of the female tapers gradually to end in a conoid tail to which a fine acicular process is appended.

*Host*.—*Agama colonorum*.

*Location*.—Intestine.

*Locality*.—Du River, Liberia.

*Type*.—Male and female, Cat. No. 8015, U.S.N.M., Helm. Coll.

*Paratypes*.—Male and females, Cat. No. 8016, U.S.N.M., Helm. Coll.

The species described above which appears to be the first member of the genus described from an African reptile, may be differentiated from previously described members of the genus on the basis of (1) its unstriated cephalic cuticular swelling, (2) the narrow and relatively simple spicules, which are also shorter than in other species, and (3) the smaller eggs.

## NEMATODA

### Family STRONGYLIDAE

#### COLOBOSTRONGYLUS, new genus.

*Generic diagnosis*.—Strongylidae: Comparatively large worms with mouth directed straight forward. Buccal capsule infundibular and with thick walls. An external leaf crown with numerous slender elements and an internal leaf crown of minute elements present. Only the amphids, or so-called lateral papillae, are prominent in the circumoral region. Cervical papillae very minute or absent. Anterior portion of esophagus bent away from the main axis of the esophagus;



from its dilated funnel-shaped portion, three narrow teeth project into the mouth capsule. Male bursa with lateral lobes and an inconspicuous dorsal lobe. Ray formula as in genus *Oesophagostomum*. Spicules long and narrow, with knobbed proximal ends and without a sheath. Gubernaculum present. Tail of female mucronate. Anus and vulva open close together near tail. Vagina long, opening into two kidney-shaped chambers (pars ejaculatrix) which communicate with long ovejectors and parallel uteri.

*Type species.*—*Colobostrongylus strongi*, new species.

**COLOBOSTRONGYLUS STRONGI, new species**

*Specific diagnosis.*—*Colobostrongylus*: In the preserved state the worms are girdled either at their anterior or posterior extremities with a belt of brownish-black material resembling clotted blood. They are yellowish in color and robust in build. Body cylindrical, tapering toward the anterior extremity. The cuticle is finely striated, and, as a marking superimposed on the general striation, the cuticle is coarsely crinkled in the anterior and posterior regions of the body. Head region well defined. There are four circumoral papillae and two amphids, or so-called lateral papillae. The submedian, dorsal, and ventral papillae are flat, and visible only when the head is cut off and viewed on end. The amphids are fairly conspicuous, and with a broad base, provided with a terminal sensory filament. Mouth directed straight forward, with comparatively narrow mouth collar. Diameter of mouth, 0.085 mm. Mouth capsule broader than long, measuring 0.12 mm. by 0.11 mm., and with a thick chitinous wall. The dorsal gutter of the esophageal gland was not visible, and is probably absent. There are two leaf crowns, the external composed of 24 narrow elements, which project for a short distance beyond the mouth aperture, and an internal leaf crown consisting of exceedingly minute peglike elements, whose number can not be accurately computed. The esophagus is clavate, the posterior swollen portion being  $230\mu$  wide. Its anterior quarter is bent at an angle from the main axis of the esophagus, and anteriorly it is widened out to form a funnel from the base of which there projects, halfway into the buccal cavity, a chitinous trident composed of three narrow lancets. In some specimens the trident is rather difficult to see on account of débris obscuring the view. Excretory tubule very narrow, opening at a level with the kink in the esophagus, 0.31 mm. from the anterior extremity. Cervical papillae were not visible.

*Male.*—From 24 mm. to 26 mm. in length with a maximum breadth of 0.47 mm. near the middle. Bursa short, measuring 0.23 mm. long by 0.4 mm. wide. Ray formula similar to that of the genus *Oesophagostomum*; ventral rays cleft near their base and parallel. Externolateral and other lateral rays arise from a common trunk; the former diverges and its tip does not quite reach to the margin of the bursa,

while the mediolateral and posterolateral rays are parallel, and extend to the margin of the bursa. The externodorsal rays, which are relatively slender, arise from a common trunk with the dorsal ray. The latter divides near its middle, and each branch bifurcates terminally. Spicules equal in length, filiform and unsheathed. They measure 1.23 mm. in length, and their termini are without barbs. A slender, curved gubernaculum, about 0.10 mm. long, is present.

*Female*.—From 30 to 31 mm. in length, with maximum breadth in the posterior half of the body of 0.78 mm. Esophagus 0.78 mm. long. Measurements of buccal cavity approximate those of the male. The posterior half of the body tapers conically, to terminate in a sharp mucronate tail. Anus opens about 0.15 mm. from tip of the tail, and the vulva, which does not have salient lips, is situated about an equal distance anterior to the anus. Muscular vagina about 0.28 mm. long. It bifurcates into two more or less kidney-shaped chambers, that receive two convergent ovejectors, which are continuous with the parallel uteri. Eggs (in uterus) thin shelled, measuring, on the average,  $80\mu$  by  $40\mu$ .

*Host*.—*Colobus polykomos* ("Black and white" Colobus monkey).

*Location*.—Small intestine (?).

*Locality*.—Du River, Liberia.

*Type*.—Male and female, Cat. No. 8017, U.S.N.M., Helm. Coll.

*Paratypes*.—Cat. No. 8018, U.S.N.M., Helm. Coll.

Nine female and seven male specimens of the parasite described above were found free in the lumen of the small intestine of the host, which, at the time of examination, had been dead for several hours. Cysts, the size of a pea, resembling those produced by *Oesophagostomum* were seen by Dr. Max Theiler, a member of the expedition, on the walls of the cecum, but on dissection of one of these cysts no parasites were found. Because of the generic affinities of the worms, it seems not unlikely that the normal habitat of the parasite is in the large intestine and that, in the present case, post-mortem migration had occurred.

The characters described in the diagnosis can not be reconciled with those of any known genus of the Strongyloidea. On the basis of the shape of the buccal cavity and the associated oral structures, the status of the parasite would seem to fall between the two chief sub-families, the Strongylinae and the Trichoneminae, but in other characteristics it exhibits affinities with the Oesphagostominae. The shape of the buccal cavity is closer to that of the Strongylinae, but the absence of a dorsal esophageal gland prolonged as a ridge on the dorsal wall of the buccal capsule is more characteristic of the Trichoneminae. If it were not for the lack of a transverse ventral cervical groove and of any semblance of cephalic inflations, an affinity with the Oesphagostominae would be indicated, especially since the

bursal ray formula is practically identical with, and the dental armature of the esophagus resembles these structures in *Ternidens*, a typical genus of the Oesophagostominae. In view of these considerations, the writer has refrained from indicating the subfamily relation of *Colobostrongylus*. It seems, however, that the Oesophagostominae, as at present defined, constitute an artificial group, necessitating the allocation to other subfamilies of several genera (as *Oesophagostomoides* Schwartz, 1928) whose characteristics show a close affinity with the type genus *Oesophagostomum*.

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#### EXPLANATION OF PLATES

Abbreviations: *a.* acetabulum; *an.* anus; *c.* cirrus organ; *d.* dorsal ray; *exd.* externo-dorsal ray; *exl.* externo-lateral; *exv.* excretory vessels; *g. p.* genital pore; *gub.* gubernaculum; *i.* intestinal caeca; *l. v.* latero-ventral; *met.* metraterm; *m. l.* medio-lateral; *o.* ovary; *oe.* esophagus; *os.* oral sucker; *ph.* pharynx; *p. l.* postero-lateral; *pp.* prebursal papilla; *s. r.* seminal receptacle; *t1* and *t2* anterior and posterior testes; *u.* uterus; *v.* vitellaria; *vu.* vulva; *v. v.* ventro-ventral.

#### PLATE I

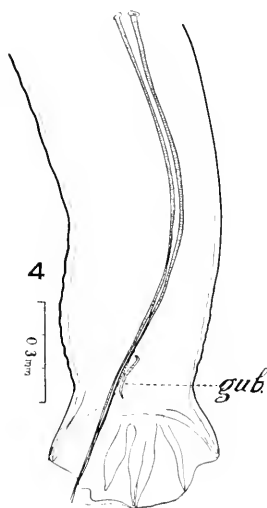
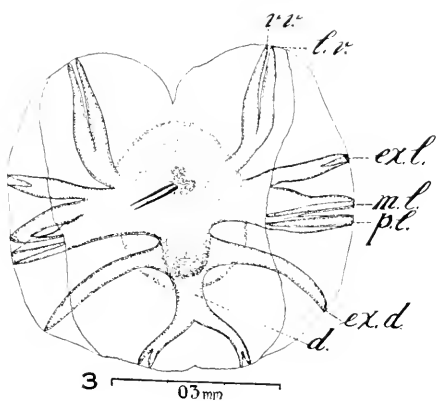
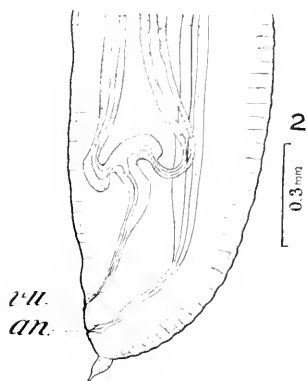
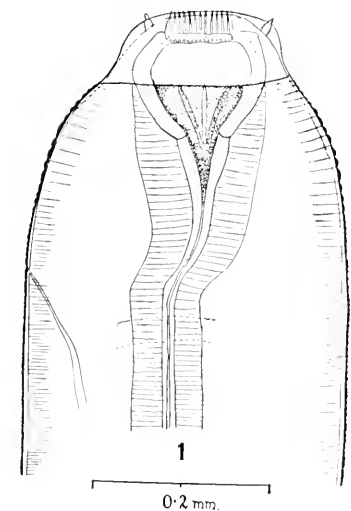
##### *Colobostrongylus strongi*

- FIG. 1. Anterior extremity showing buccal teeth and kink in esophagus.  
 2. Posterior extremity of female showing vulva, vagina, etc.  
 3. Bursa of male flattened out to show distribution of rays.  
 4. Posterior extremity of male.

#### PLATE 2

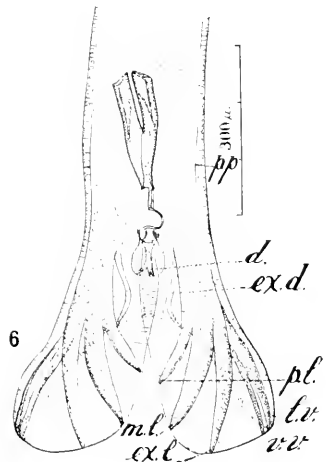
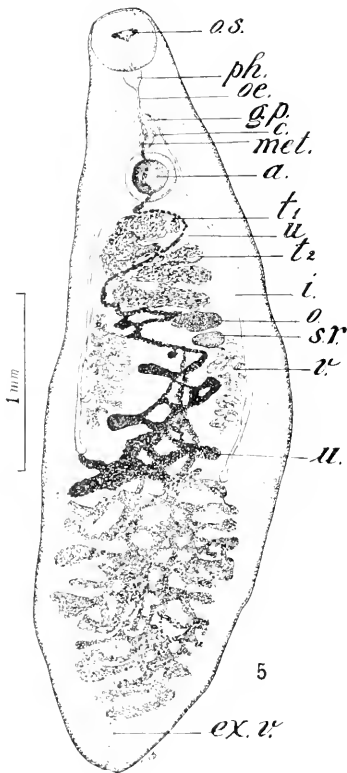
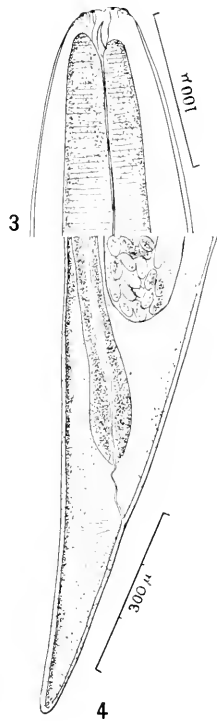
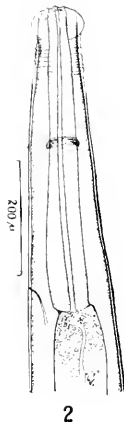
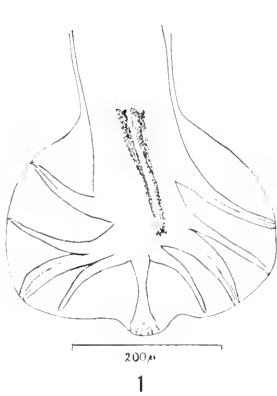
- FIG. 1. *Oswaldocruzia agamae*, caudal extremity of male with bursa spread.  
 2. *Oswaldocruzia agamae*, anterior extremity of female.  
 3. *Leiperiatus hopkeni*, anterior extremity from the dorsal aspect.  
 4. *Leiperiatus hopkeni*, caudal extremity of female viewed from the side.  
 6. *Leiperiatus hopkeni*, caudal extremity of male with bursa spread.  
 5. *Dicrocoelium colobosicola*, ventral view showing topography of organs.





COLOBOSTROMYLUS STRONGI

FOR EXPLANATION OF PLATE SEE PAGE 11



OSWALDOCRUZIA AGAMAE, LEIPERIATUS HOPKENI, AND DICROCOELIUM COLOBOSICOLA

FOR EXPLANATION OF PLATE SEE PAGE 11

# BUGS OF THE FAMILY MIRIDAE OF THE DISTRICT OF COLUMBIA AND VICINITY

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The Miridae, formerly known as Capsidae, have commonly been called plant-bugs, but it is now known that numerous species among them are predaceous. They are more numerous in species than any other family of Heteroptera and 200 species (counting a single variety to each) and 23 additional varieties have been collected within a 20-25 mile radius of Washington, D. C. This result may be compared with the list of 296 species and 53 additional varieties from a much larger area, the entire State of New York.<sup>1</sup> The District of Columbia list contains 57 species that are not represented in the New York catalogue, and the latter has 153 species that are not in the former. There are 144 species common to the two lists.

For the benefit of those interested in the fauna of Plummer Island, Md., it may be said that 88 species and 8 additional varieties of Miridae have been collected on the island, and 43 other species and 7 varieties in the Great Falls-Little Falls section of the Potomac River valley. When not made clear by the wording of the text, these features of local distribution are indicated by the abbreviations P. I. and V. P. I.

The list includes records of all available specimens in the collections of the United States National Museum, of the United States Biological Survey, the private collections of the authors, and the Otto Heidemann collection in Cornell University. Records from the collection of the University of Helsingfors where there is much material sent to Dr. O. M. Reuter by Heidemann have been transcribed for us by Dr. Hakan Lindberg to whom we are greatly in-

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<sup>1</sup> Mem. 101, Cornell Agr. Exp. Sta., 1928, pp. 110-134.

debted indeed for this assistance. Names of collectors in the following list are given with initials, except in the case of the six most frequently mentioned. These are: H. S. Barber, Otto Heidemann, H. H. Knight, W. L. McAtee, Theodore Pergande, and E. A. Schwarz.

### Subfamily PHYLIINAE

#### Genus STHENARUS Fieber

##### STHENARUS MCATEEI Knight

Odenton, Md., July 12, 1914, July 29, 1917, on foliage of wild grape, McAtee.

#### Genus CHLAMYDATUS Curtis

##### CHLAMYDATUS SUAVIS Reuter

Washington, D. C., August 27, 28, September 1, Heidemann; July 25, August 6, 26, 1926. Knight; Beltsville, Md., August 14, 1914, McAtee.

##### CHLAMYDATUS ASSOCIATUS Uhler

Beltsville, Md., July 3, 1926, McAtee.

#### Genus LEUCOPOECILA Reuter

##### LEUCOPOECILA ALBOFASCIATA Reuter

Washington, D. C., June 11, November 11, 1886, Pergande; September 13, 1913, McAtee; Arlington Farm, Va., October, 1921, P. L. Ricker, abundant and destructive at this time; Virginia, October 5, Pergande.

#### Genus PLAGIOGNATHUS Fieber

##### PLAGIOGNATHUS POLITUS var. POLITUS Uhler

Generally distributed and common; season May 18 to October 11; usually on foliage of shrubs and weeds, including *Ambrosia trifida*, but has been taken on flowers of *Ceanothus*, *Yucca*, *Leonurus cardiaca*, and *Cornus amomum*. P. I.

##### PLAGIOGNATHUS POLITUS var. FLAVEOLUS Knight

Fairly common, apparently a fall form, September 4–November 3; has been taken on flowers of *Bidens trichosperma*. P. I.

##### PLAGIOGNATHUS NIGRONITENS Knight

Vienna, Va., July 11, 25, 1926. Knight; Beltsville, Md., July 3, 1926. Knight.

##### PLAGIOGNATHUS TINCTUS Knight

Plummer Island, Md., June 7, 1914, McAtee; Eastern Branch near Bennings, D. C., June 7, 1914; Four-mile Run, Va., May 31, 1914, A. Wetmore; Glencarlyn to mouth of Four-mile Run, Va., June 17, 1914, McAtee.



**PLAGIOGNATHUS FLAVOSCUTELLATUS Knight**

Plummer Island, Md., June 7, 1914, McAtee; July 20, 1926, on willow, Knight.

**PLAGIOGNATHUS ANNULATUS var. CUNEATUS Knight**

Great Falls, Md., June 18, Barber; Plummer Island, Md., June 6, 1905, August 19, 1902, Schwarz and Barber; June 17, 1913, J. D. Hood.

**PLAGIOGNATHUS CARINATUS Knight**

Forest Glen, Md., June 2, 1913, Heideman; Great Falls, Md., May 23, 1915, McAtee; Beltsville, Md., July 3, 1926, on persimmon, Knight.

**PLAGIOGNATHUS SERICEUS Heidemann**

Abundant on flowers of various species of *Tilia* in the parks and streets of Washington, dates May 27 to June 20; has been taken also at Beltsville, Md., June 9, 1915, and at Odenton, Md., June 20, 1913, McAtee.

**PLAGIOGNATHUS NIGROLINEATUS Knight**

Dyke, Va., May 28, 1913, on *Rhus glabra*, McAtee, probably attracted only to flowers; known to breed on *Quercus* in other localities.

**PLAGIOGNATHUS ATRICORNIS Knight**

Glen Echo, Md., July 10; Bladensburg, Md., July 23, 1890, "on black birch"; Forest Glen, Md., July 6, 1913, Heidemann.

**PLAGIOGNATHUS ALBIFACIES Knight**

Fairly common: dates of collection range from July 6 to September 15. P. I.

**PLAGIOGNATHUS BLATCHLEYI var. NUBILUS Knight**

Washington, D. C., June 12, August 7, 1884, September 5, 1890, October 2, 1889; Great Falls, Va., August 10, 1906, Heidemann.

**PLAGIOGNATHUS ALBATUS var. ALBATUS Van Duzee**

Fairly common and well distributed; has been collected as early as May 2 and as late as July 12. P. I.

**PLAGIOGNATHUS ALBATUS var. VITTISCUTIS Knight**

Washington, D. C., July 15, 1894, Heidemann; Branchville to Beltsville, Md., June 4, 1914, E. R. Kalmbach; Great Falls, Md., May 23, 1915; Glencarlynn to mouth of Four-mile Run, Va., June 17, 1914, McAtee.

**PLAGIOGNATHUS SIMILIS var. SIMILIS Knight**

Glencarlyn to mouth of Four-mile Run, Va., June 17, 1914, McAtee;  
Plummer Island, Md., July 20, 1926, Knight.

**PLAGIOGNATHUS SIMILIS var. FURVUS Knight**

Plummer Island, Md., July 20, 1926, Knight.

**PLAGIOGNATHUS ROSICOLA Knight**

Great Falls, Md., July 5, 1905; Plummer Island, Md., on wild  
roses, June 30, 1905, Heidemann.

**PLAGIOGNATHUS FULVIDUS Knight**

Odenton, Md., July 4, 1913, July 12, 1914, McAtee.

**PLAGIOGNATHUS DELICATUS Uhler**

The food plant of this species is honey locust (*Gleditsia triacanthos*)  
upon which it is sometimes common; adults have been collected from  
May 13 to June 21.

**PLAGIOGNATHUS CORNICOLA Knight**

Mount Vernon, Va., June 27, 1915, on *Cornum amomum*; Belts-  
ville, Md., June 23, 1918, McAtee.

**PLAGIOGNATHUS PUNCTATIPES Knight**

Glencarlyn, Va., May 30, 1906, D. H. Clemons; Washington, D. C.,  
July 17, 1907, McAtee.

**PLAGIOGNATHUS DISPAR Knight**

Forest Glen, Md., June 21, 1914, Heidemann; Glen Echo, Md.,  
June 10, 1923, J. R. Malloch.

**PLAGIOGNATHUS CARNEOLUS Knight**

Odenton, Md., May 5, 1918, McAtee; Falls Church, Va., May 13,  
1901, S. A. Rohwer.

**Genus MICROPHYLELLUS Reuter****MICROPHYLELLUS MODESTUS Reuter**

Fairly common May 7 to June 17; frequent on elm where it has  
been observed preying on *Schizoneura americana*; has been taken on  
hickory also, and on flowers of *Tilia americana*. P. I.

**MICROPHYLELLUS LONGIROSTRIS Knight**

Glen Echo, Md., June 17, 1923, McAtee.

## Genus RHINOCAPSUS Uhler

## RHINOCAPSUS VANDUZEEI Uhler

Rock Creek, D. C., June 24, 1906; Glencarlyn, Va., July 1, 1906, D. H. Clemons; Beltsville, Md., June 14, 1914, June 23, 1918, McAtee.

## Genus CRIOCORIS Fieber

## CRIOCORIS SALIENS Reuter

Maryland near Plummer Island, May 18, 1913, May 24, 1914, June 7, 1914; Branchville to Beltsville, Md., June 4, 1914; Maywood, Va., May 21, 1922, McAtee.

## Genus PSALLUS Fieber

## PSALLUS ANCORIFER Fieber

Fairly common and well distributed; has been collected from May 22 to July 11; breeds on clover.

## PSALLUS MORRISONI Knight

Beltsville, Md., July 4, 1915, McAtee; Glen Echo, Md., July 12, 1922, at light, J. R. Malloch; Scott's Run, Va., August 2, 1914, L. O. Jackson.

## PSALLUS CLAVICORNIS Knight

Washington, D. C., March 3, 1880, Pergande.

## Genus LEPIDOPSALLUS Knight

## LEPIDOPSALLUS CLARICORNIS Knight

Washington, D. C., May 20, June 8, 1905, Heidemann; Little Hunting Creek, Va., May 24, 1914, A. Wetmore.

## LEPIDOPSALLUS RUBIDUS Uhler

Washington, D. C., June 23, 1897, July 6, 1893, Heidemann; Great Falls, Va., July 18, 1926, on willow, Knight.

## LEPIDOPSALLUS OLSENI Knight

Branchville to Beltsville, Md., June 4, 1914; Beltsville, Md., June 15, 1913, McAtee.

## Genus REUTEROSCOPIUS Kirkaldy

## REUTEROSCOPIUS ORNATUS Reuter

Abundant and generally distributed; season June 7 to October 11; usually on ragweed (*Ambrosia*); comes to light. P. I.

## REUTEROSCOPIUS SULPHUREUS Reuter

Hyattsville, Md., September 6, 1914, on *Solanum carolinianum*;  
Beltsville, Md., July 3, 1926, McAtee; Washington, D. C., July 3,  
1926, Knight.

## Genus LOPUS Hahn

## LOPUS DECOLOR Fallen

Rock Creek, D. C., June 17, 1902, Heidemann; Beltsville, Md.,  
July 4, 1912; Odenton, Md., July 12, 1914, McAtee; Vienna, Va.,  
July 11, 1926, Knight.

## Subfamily DICYPHINAE

## Genus HYALIODES Reuter

## HYALIODES VITRIPENNIS var. VITRIPENNIS Say

Common, season June 6 to September 27; predacious, occasionally  
bites man; observed preying on *Dactylopius*, on sycamore, August  
21, 1879; is common on mulberry among *Corythucha pallida*. P. I.

## HYALIODES VITRIPENNIS var. DISCOIDALIS Reuter

Common, with the typical variety; records from June 8 to August  
22. P. I.

## Genus DICYPHUS Fieber

## DICYPHUS AGILIS Uhler

Rosslyn, Va., July 7, Heidemann.

## DICYPHUS MINIMUS Uhler

Washington, D. C., May 15, 1899, June 8, 1898, on tobacco,  
Heidemann.

## DICYPHUS FAMELICUS Uhler

Washington, D. C., June 7, 1885, July 4, 1887, Heidemann.

## Genus MACROLOPHUS Fieber

## MACROLOPHUS BREVICORNIS Knight

Washington, D. C., July 2, 1904, Heidemann.

## MACROLOPHUS SEPARATUS Uhler

Bladensburg, Md., July 7, September 11, 1892; Odenton, Md.,  
July 17, 1906; Washington, D. C., August 5, 1885, Heidemann;  
Glencarlyn, Va., September 14, 1918, McAtee.

## Subfamily BRYOCORINAE

## Genus MONALOCORIS Dahlbom

## MONALOCORIS FILICIS Linnaeus

May be collected on ferns almost anywhere; season for adults as now known is May 4 to August 22. P. I.

## Genus PYCNODERES Guerin

## PYCNODERES DILATATUS Reuter

Common; active season May 20 to October 30; sieved December 14, February 23; collected in flowers of *Pontederia*, September 24; frequent on oak sprouts. P. I.

## PYCNODERES OBSCURATUS Knight

Great Falls, Va., June 30, 1914, A. Wetmore; Glen Echo, Md., summer 1922, J. C. Bridwell.

## Genus SIXEONOTUS Reuter

## SIXEONOTUS INSIGNIS Reuter

Fairly common; adults have been collected from June 6 to August 21; food plants include *Chenopodium album*, *Nabalus albus*, and *Mesadenia atriplicifolia*. P. I.

## SIXEONOTUS TENEBROSUS Distant

Washington, D. C., June 8, 1905, June 15, 1891, August 10, 1887, Heidemann.

## Subfamily CYLAPINAE

## Genus CYLAPUS Say

## CYLAPUS TENUICORNIS Say

Rather commonly collected when its haunts are understood; frequents fallen limbs and trunks especially those having velvety fungus growths; adults have been collected from July 4 to September 25, and nymphs from May 3 to August 11. P. I.

## Genus FULVIUS Stal

## FULVIUS BRUNNEUS Provancher

Fairly common in haunts somewhat similar to those of *Cylapus tenuicornis* but on boards or logs more in contact with the ground. Season July 9 to August 30; comes to light. P. I.

**FULVIUS IMBECILIS** Say

Remarks under the preceding species apply; season July 5 to September 17. P. I.

**Genus PERITROPIS** Uhler**PERITROPIS SALDAEFORMIS** Uhler

Bladensburg, Md., July 20, 28, 1890, nymphs and adults on dry branches of trees, Heidemann.

**Subfamily CLIVINEMINAE****Genus BOTHYNOTUS****BOTHYNOTUS MODESTUS** Wirtner

Maryland near Plummer Island, June 17, 1913, J. D. Hood.

**Subfamily DERAEOCORINAE****Genus EUSTICTUS** Reuter**EUSTICTUS FILICORNIS** Walker

Washington, D. C., July 12, 1890; Bladensburg, Md., July 20, 1890, O. Heidemann.

**EUSTICTUS NECOPINUS** Knight

Stubblefield Fall, Va., July 4, 1918, on hickory, McAtee.

**EUSTICTUS SALICICOLA** Knight

Glen Echo, Md., July 23, 1921, J. R. Malloch.

**Genus EURYCHILOPTERELLA** Reuter**EURYCHILOPTERELLA LURIDULA** Reuter

The original material of this species was collected on trees in the Department of Agriculture grounds, on which the nymphs resembling mealybugs were observed, and from which adults were reared. The dates it has been collected in Washington run from June 12 to July 30; specimens are at hand also from Bladensburg, Md., July 10, 1909, Heidemann; and Glen Echo, Md., July 2, 1922, J. R. Malloch.

**Genus DERAEOCORIS** Kirschbaum**DERAEOCORIS NEBULOSUS** Uhler

Fairly common, active season March 25 to November 8; frequent on alder; collected also on hickory and *Ptelea trifoliata*; under bark of sycamore December 6, under birch bark, February 9; comes to light. P. I.

**DERAEOCORIS POECILUS** McAtee

Fairly common; active season March 8 to August 21; occurs on *Alnus rugosa*; collected under bark of birch, maple, and sycamore in winter. P. I.

**DERAEOCORIS HISTRIO** Reuter

District of Columbia, February 21, 1887, November 24, 1886, Pergande; April 17 (Uhler collection).

**DERAEOCORIS NUBILUS** Knight

Virginia, October 5, Pergande.

**DERAEOCORIS FASCIOLUS** var. **CASTUS** Knight

Rock Creek Park, D. C., June 26, 1921; Glen Echo, Md., June 11, 25, July 16, 1922, J. R. Malloch.

**DERAEOCORIS GRANDIS** Uhler

Several specimens have been taken on Plummer Island, Md., at dates ranging from June 4 to July 8, once at light; there is a record also for Beltsville, Md., June 14, 1914, McAtee.

**DERAEOCORIS APHIDIPHAGUS** Knight

Glen Echo, Md., July 15, 1893 (Uhler collection); Plummer Island, Md., June 15, 1902, Heideman; June 4, 1905; Washington, D. C., July 6, 1907, McAtee; Great Falls, Va., July 18, 1926, Knight; Mount Vernon, Va., June 6, 27, 1915, McAtee; Pergande records it as feeding on *Schizoneura americana*.

**DERAEOCORIS QUERCICOLA** Knight

Washington, D. C., July 2, 1907, Heidemann; June 15, 1925, on *Quercus macrocarpa*; Beltsville, Md., June 23, 1918, on *Quercus alba*, McAtee.

**DERAEOCORIS NITENATUS** Knight

Fairly common; dates of collection range from May 25 to September 2. P. I.

**DERAEOCORIS NIGRITULUS** Knight

Common on *Pinus virginiana*; season May 9 to July 12. V. P. I.

**DERAEOCORIS SAYI** Reuter

Plummers Island, Md., July 8, 1907, Schwarz.

Subfamily **ORTHOTYLINEAE**Genus **SEMIUM** Reuter**SEMIUM HIRTUM** Reuter

This little species is seen more often than collected, its agility rendering it difficult to capture, and its delicacy of structure results in

most captures being so damaged as not to be worth preserving; the insect is found on the underside of leaves, or on sand beneath the leaves, of species of *Euphorbia* (*Tithymalopsis*); records for specimens at hand are Washington, D. C., July 20, 1894, 1899, August 12, 15, 20, 22. Heidemann; Falls Church, Va., N. Banks.

**Genus PARTHENICUS Reuter**

**PARTHENICUS JUNIPERI Heidemann**

Fairly common on red cedar; has been taken also on Virginia pine; season for adults June 8 to October 12. P. I.

**Genus HALTICUS Hahn**

**HALTICUS CITRI Ashmead**

Abundant, season May 9 to October 30. P. I.

**Genus STRONGYLOCORIS Blanchard**

**STRONGYLOCORIS STYGICUS Say**

Common; adults have been collected from May 9 to August 8, and nymphs from May 4 to 18. P. I.

**Genus ILNACORA Reuter**

**ILNACORA MALINA Uhler**

Common; May 30 to July 4. P. I.

**ILNACORA STALII Reuter**

Fairly common on giant ragweed (*Ambrosia trifida*). June 16 to August 16. P. I.

**Genus LOPIDEA Uhler**

**LOPIDEA CONFLUENS Say**

Fairly common, May 24 to September 5. P. I.

**LOPIDEA DAVISI Knight**

Washington, D. C., June, 1916, F. H. Chittenden; near Chevy Chase, Md., July 6, 1913, McAtee; Takoma Park, Md., August 15, 1916, on phlox; Glen Echo, Md., August 22, 1922, McAtee; Glen Echo, Md., July 25, 1926, Knight; Plummer Island, Md., June 24, 1906, McAtee.

**LOPIDEA HEIDEMANNI Knight**

Common, May 18 to August; breeds on elm, yarrow, and phlox; has been collected also on asparagus, black walnut, and Virginia pine. P. I.



## LOPIDEA INCURVA Knight

Maryland near Plummer Island, June 22, 1921, nymphs and adults on honey locust, Barber; Washington, D. C., July 12, 19, 1926, on honey locust, Knight.

## LOPIDEA ROBINIAE Uhler

Abundant on black locust (*Robinia pseudacacia*); adults have been collected from June 7 to August 19, and nymphs from June 8 to July 29; occasionally taken on other plants, including scrub pine, grape, yucca, and wild carrot; comes to light. P. I.

## LOPIDEA MEDIA Say

Common May 12 to July 19; on alder (*Alnus rugosa*); a specimen was found sucking a carabid beetle (*Harpalus*), July 19, 1913. R. C. Shannon. P. I.

## LOPIDEA SAYI Knight

New Alexandria, Va., Plummer Island, Md., July 1907, William Palmer; Plummer Id., Md., June 15, 1902, Heidemann; June 29, 1913, R. C. Shannon; July 7, 21, 1907, A. K. Fisher; July 20, 1926, on hornbeam (*Ostrya virginiana*), Knight.

## LOPIDEA STAPHYLEAE Knight

Collected on Plummer Island, Md., on numerous dates ranging from June 15 to August 9; also at Scott's Run, Va., on August 2, 1914. McAtee; and at Great Falls, Va., June 27, N. Banks.

## LOPIDEA REUTERI Knight

Glencarlyn, Va., July 25, N. Banks.

## LOPIDEA CAESAR Reuter

Glencarlyn, Va., July 1, 1906, D. H. Clemons.

## LOPIDEA INSTABILIS var. INSTABILIS Reuter

Fairly common, June 23 to August 12; on goldenrod. V. P. I.

## LOPIDEA INSTABILIS var. MARGINALIS Reuter

Glen Echo, Md., July 20, Heidemann; Washington, D. C., June 30 to August 6, 1926, Knight.

## Genus MELANOTRICHUS Reuter

## MELANOTRICHUS FLAVOSPARSUS Sahlberg

Abundant on *Chenopodium* spp; May 23 to September 29; comes to light. V. P. I.

## MELANOTRICHUS CATULUS Van Duzee

Washington, D. C., May 16, 1902, Heidemann.

Genus **ORTHOTYLUS** Fieber**ORTHOTYLUS CHLORIONIS** Say

Abundant on honey locust; April 6 to June 10. V. P. I.

**ORTHOTYLUS SUBMARGINATUS** Say

Washington, D. C., June 20, July 10, 28, Forest Glen, Md., June 13, 1914, Heidemann; Plummer Island, Md., July 11, Barber; Odenton, Md., July 4, 1913, McAtee; Vienna, Va., July 11, 1926, Knight; host black locust (*Robinia pseudacacia*).

**ORTHOTYLUS VIRIDIS** Van Duzee

Fairly common, on *Salix nigra*, June 4 to July 26. P. I.

**ORTHOTYLUS MODESTUS** Van Duzee

Fairly common on *Salix nigra*, June 4 to July 4. P. I.

Genus **DIAPHNIDIA** Uhler**DIAPHNIDIA CAPITATA** Van Duzee

Washington, D. C., June 11, 1886; Rock Creek, D. C., June 17, 1893, Heidemann.

**DIAPHNIDIA PELLUCIDA** Uhler

Fairly numerous; season May 31 to July 20; has been collected on black locust, on white oak, and on bur oak (the latter in a park).

**DIAPHNIDIA HEIDEMANNI** Knight

Collected at Washington, D. C., by Heidemann at dates ranging from May 7 to October 15; and at Henson's Creek, Md., July 4, 1887; Heidemann gave the food plant as ash.

Genus **REUTERIA** Puton**REUTERIA IRRORATA** Say

Common, June 30 to August 20; has been collected on elm, chestnut, and hickory; comes to light. P. I.

Genus **CERATOCAPSUS** Reuter**CERATOCAPSUS MCATEEI** Knight

Odenton, Md., July 12, 1914; Laurel, Md., October 11, 1914, McAtee.

**CERATOCAPSUS MODESTUS** Uhler

Common, July 4 to August 3; occurs on hickory, oak, and chestnut; comes to light. P. I.

**CERATOCAPSUS NIGELLUS Knight**

Odenton, Md., July 12, 1914; Veitch, Va., June 17, 1914, on chestnut, McAtee.

**CERATOCAPSUS RUBRICORNIS Knight**

Washington, D. C., July 12, 1891, Heidemann.

**CERATOCAPSUS FASCIATUS Uhler**

Common on hickory; season as shown by collected specimens, June 30 to August 29.

**CERATOCAPSUS SETOSUS Reuter**

Fairly common, on ferns, April 25 to August 30; comes to light. P. I.

**CERATOCAPSUS PUMILUS Uhler**

Fairly common, May 20 to August 20. P. I.

**CERATOCAPSUS FUSCINUS Knight**

Washington, D. C., May 11, 1905. D. H. Clemons; June 22, 1890, July 10, 1898, Heidemann; June 30, 1919, L. L. Buchanan; Glen Echo, Md., July 10, Heidemann; Plummer Island, Md., July 14, 1915, McAtee.

**CERATOCAPSUS VICINUS Knight**

Odenton, Md., July 12, 1914, July 29, 1917, on chestnut, McAtee.

**CERATOCAPSUS DIGITULUS Knight**

Odenton, Md., July 10, 1918; Great Falls, Va., August 21, 1917, McAtee.

**CERATOCAPSUS BARBATUS Knight**

Frequent; season June 14 to August 8; occurs on Virginia pine. V. P. I.

**CERATOCAPSUS UNIFORMIS Knight**

Washington, D. C., July 30, 1907; Plummer Id., Md., July 19, 1914; August 2, 1914; Odenton, Md., July 12, 1914; Mount Vernon, Va., August 1, 1915. McAtee.

**CERATOCAPSUS COMPLICATUS Knight**

Beltsville, Md., August 14, 1914; Odenton, Md., July 29, 1917, on *Vitis*; Scotts Run to Ball's Hill, Va., August 12, 1917, McAtee.

**CERATOCAPSUS QUADRISPICULUS Knight**

Glen Echo, Md., July 23, 1922. J. R. Malloch.

**Genus ALEPIDIELLA****ALEPIDIELLA HEIDEMANNI Poppius**

Washington, D. C., July 18, 1907, McAtee; July 11, 1924, at light, J. R. Malloch; Glen Echo, Md., July 17, 1926, on *Pinus virginiana*, Knight.

**Genus ALEPIDIA Reuter****ALEPIDIA GRACILIS var. GRACILIS Uhler**

Washington, D. C., July 28, 1880, July 4, 1881, Pergande; June 29, 1897, Heidemann; Plummer Id., Md., July 14, 1915, McAtee.

**ALEPIDIA GRACILIS var. SQUAMOSA Knight**

Glen Echo, Md., July 17, 25, 1926; Vienna, Va., July 11, 1926; Knight.

**Genus PILOPHORUS Hahn****PILOPHORUS DEPICTUS Knight**

Washington, D. C., July 12, 1909, Heidemann; Beltsville, Md., June 15, 1915, on *Pinus virginiana*, McAtee.

**PILOPHORUS CRASSIPES Heidemann**

Common, on *Pinus virginiana*, June 8 to October 4. P. I.

**PILOPHORUS AMOENUS Uhler**

The most common species of the genus, occurs on *Pinus virginiana*, June 8 to August 14. V. P. I.

**PILOPHORUS LAETUS Van Duzee**

Common; season of collection June 15 to September 3; occurs on Virginia pine. V. P. I.

**PILOPHORUS JUNIPERI Knight**

Washington, D. C., July 8, 1925, July 12, 1926, Knight; Plummer Id., Md., July 14, 1915, McAtee; host red cedar (*Juniperus virginiana*).

**PILOPHORUS WALSHI Uhler**

Washington, D. C., July 6, 1897; July 15, on *Prunus pissardii*, Heidemann; Washington, D. C., July 8, 1926, breeding on honey locust (*Gleditsia triacanthos*), Knight; Odenton, Md., July 28, 1917, on hickory; Stubblefield Fall, Va., July 4, 1918, on hickory, McAtee.

**PILOPHORUS BRUNNEUS Poppius**

Fairly common, June 4 to August 17, occurs on hickory, willow, and alder. P. I.

**Genus SERICOPHANES Reuter****SERICOPHANES HEIDEMANNI Poppius**

Plummer Island, Md., April 24, 1921, in trap light, Barber.

Subfamily **MIRINAE****Genus COLLARIA Provancher****COLLARIA OCVLATA Reuter**

Common, May 19 to October 14. P. I.

**Genus MIRIS Fabricius****MIRIS DOLABRATUS Linnaeus**

Common, May 6 to July 7. P. I.

**Genus TRIGONOTYLUS Fieber****TRIGONOTYLUS RUFICORNIS Geoffroy**

Plummer Island, Md., July 26, 1903, Heidemann.

**TRIGONOTYLUS PULCHER Reuter**

Washington, D. C., September 17, 1889, November 3, 1903, Heidemann.

**Genus STENODEMA Laporte****STENODEMA TRISPINOSUM Reuter**

Common: adults have been collected from April 14 to October 16, and nymphs from June 8 to October 5; comes to light. P. I.

**Genus ONCEROMETOPUS Reuter****ONCEROMETOPUS NITENS Knight**

Glen Echo, Md., 1922, J. C. Bridwell.

Subfamily **CAPSINAE****Genus PLATYTYLELLUS Reuter****PLATYTYLELLUS NIGRICOLLIS Reuter**

Glen Echo, Md., summer 1922, J. C. Bridwell; Virginia near Plummer Island, Md., July 19, 20, 1913, W. D. Appel; Falls Church, Va., August 31, N. Banks.

**PLATYTYLELLUS RUBROVITTATUS Stal**

Washington, D. C., September, 10, 1889, Heidemann.

**PLATYTYLELLUS INSIGNIS** Say

Frequent; dates of collection range from June 20 to August 5. P. I.

**PLATYTYLELLUS FRATERCULUS** Knight

Plummer Island, Md., July 24, 1903, W. V. Warner; July 14, 1915, McAtee; Jacksons Island, Md., June 22, 1902, Barber; Virginia near the District of Columbia, July 19, Pergande.

**PLATYTYLELLUS CIRCUMCINCTUS** Say

Rock Creek, D. C., June 22, 29, 1890, Heidemann; Difficult Run, Va., July 12, 1906, F. Knab; Great Falls, Va., June 20, N. Banks.

**PLATYTYLELLUS INSITIVUS** var. **INSITIVUS** Say

Frequent; season June 2 to July 14. P. I.

**PLATYTYLELLUS INSITIVUS** var. **ANGUSTICOLLIS** Knight

Plummer Island, Md., June 2, 1912, Schwarz and Barber; Glencarlyn, Va., July 1, 1906, F. Knab.

**PLATYTYLELLUS FRATERNUS** var. **FRATERNUS** Knight

Lakeland, Md., June 25, 1906, F. Knab; Maryland near Plummer Island, June 13, 1914, R. C. Shannon; Maywood, Va., June 16, 1921, McAtee.

**PLATYTYLELLUS FRATERNUS** var. **RUBROMARGINATUS** Knight

Grassymead, Va., June 19, 1906, F. Knab.

**PLATYTYLELLUS FRATERNUS** var. **DISCIFER** Knight

Bladensburg, Md., June 26, 1902, Heidemann; Cabin John Bridge, Md., June 26, 1911, E. Shoemaker.

**PLATYTYLELLUS FRATERNUS** var. **REGALIS** Knight

Washington, D. C., May 4, 1884, Heidemann.

Genus **NEOBORUS** Distant**NEOBORUS AMOENUS** var. **AMOENUS** Reuter

Common on ash; adults collected from May 20 to October 12 and nymphs from May 30 to September 5; comes to light. P. I.

**NEOBORUS AMOENUS** var. **SCUTELLARIS** Reuter

With the typical variety and about as common in its season; dates of collection range from May 21 to June 19. P. I.

**NEOBORUS AMOENUS** var. **SIGNATUS** Reuter

With the typical variety but less frequent; season as shown by specimens at hand May 20 to June 5.

*NEOBORUS RUFUSCULUS* Knight

Falls Church, Va., May 13, 1914, A. Wetmore.

*NEOBORUS VITISUTIS* Knight

Plummer Island, Md., June 7, July 19, 1914; Virginia near Plummer Island, Md., June 17, 1913. McAtee; Great Falls, Va., June 13, 1908, Heidemann.

*NEOBORUS GEMINUS* Say

Plummer Island, Md., June 7, 1914, McAtee.

*NEOBORUS CANADENSIS* Van Duzee

Plummer Island, Md., May 24, 1914, McAtee.

Genus *XENOBORUS* Reuter*XENOBORUS CHIONANTHI* var. *CHIONANTHI* Knight

Has frequently been collected at Plummer Island, Md., on its host the fringe tree at dates ranging from June 6 to August 25; also at Great Falls, Va., June 13, 1908; Heidemann; and at Dunn Loring, Va., August 30, 1916, McAtee.

*XENOBORUS CHIONANTHI* var. *NIGRELLUS* Knight

Plummer Island, Md., July 20, 1926. Knight.

*XENOBORUS NEGLECTUS* Knight

Four-mile Run, Va., May 31, 1914, McAtee.

Genus *COCCOBAPHES* Uhler*COCCOBAPHES SANGUINARIUS* Uhler

Piney Branch, D. C., June 12, 1906; Washington, D. C., June, 1906, D. H. Clemons; Bladensburg, Md., June 23, 1916, R. C. Shannon; Beltsville, Md., June 23, 1918, McAtee.

Genus *LYGUS* Hahn*LYGUS PRATENSIS* var. *OBLINEATUS* Say

The most abundant heteropterous insect of the region; has been collected in the active state in every month of the year and can be obtained in dormant or semidormant condition on Virginia pine, in mullein rosettes, and among dry leaves any time in winter; frequents many kinds of flowers and sometimes becomes destructive to cultivated plants; comes to light; sometimes bites man. P. I.

*LYGUS PRATENSIS* var. *STRIGULATUS* Walker

Generally distributed; has been collected on numerous occasions at dates ranging from April 1 to August 22; found hibernating in mullein rosettes. V. P. I.

**LYGUS VANDUZEEI Knight**

Virginia near Plummer Island, Md., June 2, 1916, flowers of *Spiraea aruncus*, McAtee; known to breed on *Solidago*.

**LYGUS RUBICUNDUS Fallen**

Common, April 19 to November 14; breeds on *Salix*. P. I.

**LYGUS CAMPESTRIS Linnaeus**

Washington, D. C., July 20, 1888, June 24, 1888, on *Daucus carota*, Pergande; June 17, Heidemann; Eastern Branch near Benning, D. C., February 23, 1913, under bark of *Pinus virginiana*, McAtee.

**LYGUS PABULINUS Linnaeus**

Common, May 21 to November 3. P. I.

**LYGUS PLAGIATUS Uhler**

Generally distributed but infrequent; dates of collection range from April 22 to October 30; has been taken on giant ragweed. P. I.

**LYGUS APICALIS Fieber**

Generally distributed but infrequent; season May 4 to October 12. P. I.

**LYGUS (NEOLYGUS) GENESEENSIS Knight**

Washington, D. C., June 4, 1887; Forest Glen, Md., May 23, 30, 1915, Heidemann; May 30, 1914, on white ash; Beltsville, Md., May 14, 1914, May 31, 1920, June 23, 1918, on white oak; Odenton, Md., May 20, 1915; Dyke, Va., May 19, 1918, on white oak, McAtee.

**LYGUS (NEOLYGUS) INCONSPICUUS Knight**

Washington, D. C., June 13, 1890; Marshall Hall, Md., June 13, 1891, Heidemann; Beltsville, Md., June 14, 1914, June 23, 1918; Glencarlyn to mouth of Four-mile Run, Va., June 17, 1914, Scotts Run, Va., July 4, 1916, McAtee.

**LYGUS (NEOLYGUS) CARYAE var. SUBFUSCUS Knight**

Beltsville, Md., May 31, 1920, June 23, 1918, McAtee.

**LYGUS (NEOLYGUS) COMMUNIS Knight**

Four-mile Run, Va., May 31, 1914, McAtee.

**LYGUS (NEOLYGUS) QUERCALBAE Knight**

Beltsville, Md., June 23, 1918; May 31, 1920, McAtee.

**LYGUS (NEOLYGUS) JOHNSONI Knight**

Glencarlyn, Va., May 30, 1906, D. H. Clemons.



LYGUS (NEOLYGUS) CLAVIGENITALIS Knight

Beltsville, Md., July 4, 1915, on *Alnus rugosa*. McAtee.

LYGUS (NEOLYGUS) HIRTICULUS Van Duzee

Branchville to Beltsville, Md., June 4, 1914; Beltsville, Md., June 23, 1918, McAtee.

LYGUS (NEOLYGUS) LAUREAE Knight

Beltsville, Md., June 23, 1918, McAtee.

Genus DICHROOSCYTUS Fieber

DICHROOSCYTUS SUSPECTUS Reuter

Petworth, D. C., May 21, 1905, D. H. Clemons; Washington, D. C., May 22, 1895; Rock Creek, D. C., June 10, Heidemann; Branchville to Beltsville, Md., June 4, 1914; Beltsville, Md., June 15, 1914, McAtee.

DICHROOSCYTUS ELEGANS Heidemann

Generally distributed and apparently fairly numerous: season as so far known runs from May 9 to June 18; occurs on red cedar and Virginia pine. P. I.

DICHROOSCYTUS REPLETUS Heidemann

Collected in the District of Columbia, chiefly on red cedar, at various dates from June 7 to July 25, also at Marshall Hall, Md., June 13, 1891, Heidemann; and Cabin John, Md., June 19, 1915, V. A. Roberts.

Genus POLYMERUS Hahn

POLYMERUS BASALIS var. BASALIS Reuter

Almost as abundant as *Lygus pratensis* var. *oblineatus*; active season, April 3 to October 23; taken from mullen rosettes, Maryland near Plummer Island, January 18, 1914; breeds on ragweed and frequents various flowers; comes to light. V. P. I.

POLYMERUS BASALIS var. FUSCATUS Knight

Localities for this form as so far collected, with one exception, are on the Coastal Plain; dates range from June 15 to October 3; has been taken on evening primrose and ragweed; the Piedmont locality is Glen Echo, Md., summer 1922, J. C. Bridwell.

POLYMERUS VENATICUS Uhler

Has been encountered in small numbers on numerous occasions; dates of collection range from May 28 to July 1; breeds on golden-rod. V. P. I.

**POLYMERUS TINCTIPES** Knight

Great Falls, Md., May 3, 1915, on lichen-covered rocks, J. D. Hood.

**POLYMERUS PUNCTIPES** Knight

Branchville to Beltsville, Md., June 4, 1914, McAtee, E. R. Kalmbach; Beltsville, Md., June 9, 1915, McAtee.

**Genus POECILOCAPSUS** Reuter**POECILOCAPSUS LINEATUS** Fabricius

Fairly common; adults have been collected from May 9 to June 29 and nymphs from May 9 to July 26. P. I.

**Genus HORCIAS** Distant**HORCIAS DISLOCATUS** var. **GONIPHORUS** Say

Washington, D. C., May 18, 1887, Heidemann.

**Genus STENOTUS** Jakowleff**STENOTUS BINOTATUS** Fabricius

Common, season June 3 to July 15; breeds on grasses; comes to light. V. P. I.

**Genus ADELPHOCORIS** Reuter**ADELPHOCORIS RAPIDUS** Say

Abundant, almost as much so as *Lygus pratensis* var. *oblineatus*; adults have been collected from May 18 to October 11 and nymphs from May 19 to August 10; comes to light. P. I.

**Genus GARGANUS** Stal**GARGANUS FUSIFORMIS** Say

Common, June 7 to October 13. P. I.

**Genus PARACALOCORIS** Distant**PARACALOCORIS SCRUEUS** var. **SCRUEUS** Say

Washington, D. C., July 18, 1908, Heidemann; Beltsville, Md., June 14, 1914; June 9, 1915, McAtee; all the forms of this species seem to breed on Virginia Creeper (*Pseodera quinquefolia*).

**PARACALOCORIS SCRUEUS** var. **PERCURSUS** McAtee

Plummer Island, Md., June 7, 1914, McAtee; June 30, 1907, A. K. Fisher; Four-mile Run, Va., May 31, 1914, A. Wetmore.

## PARACALOCORIS SCRUEPUS var. BIDENS McAtee

Plummer Island, Md., June 5, 1903, W. V. Warner; June 8, 1914, at light, Schwarz and R. C. Shannon; Beltsville, Md., June 14, 1914, June 9, 1915, July 1, 1914, July 4, 1915, June 18, 1916, McAtee; July 3, 1926, Knight.

## PARACALOCORIS SCRUEPUS var. ARDENS McAtee

Chain Bridge, Md., June 9, 1905, D. H. Clemons.

## PARACALOCORIS HAWLEYI var. HAWLEYI Knight

Rock Creek, D. C., June 24, 1906, D. H. Clemons; Beltsville, Md., June 9, 1915, June 14, 1914, June 18, 1916, 1918, McAtee; this species also breeds on Virginia Creeper.

## PARACALOCORIS HAWLEYI var. ANCORA Knight

Beltsville, Md., June 14, 1914, June 18, 1916, June 23, 1918, July 4, 1916, McAtee.

## PARACALOCORIS HAWLEYI var. FISSUS McAtee

Beltsville, Md., June 14, 1914; June 18, 1916, McAtee.

## PARACALOCORIS COLON var. COLONUS McAtee

Washington, D. C., July 19, 1926, Knight; Beltsville, Md., July 4, 1915, June 14, 1914, June 23, 1918; Odenton, Md., July 10, 1918, McAtee; another breeder on Virginia Creeper.

## PARACALOCORIS COLON var. CASTUS McAtee

Beltsville, Md., June 14, 1914, June 9, July 4, 1915, McAtee; July 3, 1926, Knight.

## PARACALOCORIS COLON var. AMICULUS McAtee

Beltsville, Md., July 4, 1915; Plummer Island, Md., June 17, 1906, McAtee.

## PARACALOCORIS HEIDEMANNI var. HEIDEMANNI Reuter

Plummer Island, Md., August 5, 1914, R. C. Shannon; July 19, 26, 1914, July 14, 21, 1915, August 9, 16, 1914, McAtee; Occoquan, Va., August 19, 1917, McAtee; Vienna, Va., August 1, 8, 1926, Knight; breeds on *Hypericum prolificum*.

## PARACALOCORIS HEIDEMANNI var. ABLUTUS McAtee

Plummers Island, Md., July 14, 1915, July 19, 26, 1914, McAtee; Great Falls, Va., July 18, 1926, Knight.

**PARACALOCORIS MULTISIGNATUS** Reuter

Washington, D. C., June 7, 1884 (Uhler collection); June 22, 23, 1905; Rock Creek, D. C., June 29, 1890, Heidemann; Beltsville, Md., June 14, 1914, June 23, 1918, July 4, 1915, McAtee; breeds on Virginia Creeper.

**Genus NEUROCOLPUS** Reuter**NEUROCOLPUS NUBILUS** Say

Common, found most often on sumac flowers, but taken also on those of *Tilia americana*, *Ceanothus americanus*, *Clethra alnifolia*, and *Monarda punctata*; June 2 to September 15. P. I.

**Genus PHYTOCORIS** Fallen**PHYTOCORIS MINUTULUS** Reuter

Hyattsville, Md., August 2, 1907, D. H. Clemons; Plummer Island, Md., July 26, 1903, Barber; July 6, 1906, D. H. Clemons; August 27, 1922, J. R. Malloch.

**PHYTOCORIS PURVUS** Knight

Washington, D. C., June 30, 1926, Knight; Plummer Island, Md., June 14, 1912, Barber; August 3, 1915, R. C. Shannon; Jacksons Island, Md., June 23, 1913, Shannon and Barber; Great Falls, Md., June 18, Barber.

**PHYTOCORIS ANTENNALIS** Reuter

This interesting species is encountered only one or two at a time, but has been collected on fairly numerous occasions; dates range from June 20 to September 20. V. P. I.

**PHYTOCORIS FENESTRATUS** Reuter

A striking inhabitant of Virginia pine that has been rather seldom collected; Washington, D. C., June 3 (Uhler collection); May 16, 1902, June 27, 1895, Heidemann; Petworth, D. C., May 21, 1905, D. H. Clemons; Branchville to Beltsville, Md., June 4, 1914; Corner of Conduit and Potomac Roads, Md., May 9, 18, 1913, McAtee.

**PHYTOCORIS FUMATUS** Reuter

Washington, D. C., June 20, Heidemann; June 22, 1906, F. Knab; May 30, 1891, on walnut. June 6, 1886, June 12, 1888; Plummer Island, Md., June 30, 1905, Heidemann.

**PHYTOCORIS CORTICEVIVENS** Knight

Great Falls, Md., July 2, 1906, Heidemann.

**PHYTOCORIS CONSPURCATUS** Knight

Fairly common; season June 3 to October 12. P. I.

## PHYTOCORIS DIFFICILIS Knight

Beltsville, Md., July 3, 1926, Knight.

## PHYTOCORIS SULCATUS Knight

Washington, D. C., July, 1907, William Palmer; July 4, 1886; July 9, 1926, August 6, 1926, Knight; Falls Church, Va., July 17, N. Banks; Scott's Run to Balls' Hill, Va., August 12, 1917, McAtee.

## PHYTOCORIS SALICIS Knight

Fairly common, June 5 to October 12. P. I.

## PHYTOCORIS EXIMIUS Reuter

Common, June 15 to October 1; comes to light. P. I.

## PHYTOCORIS SPICATUS Knight

Beltsville, Md., June 14, 1914, McAtee.

## PHYTOCORIS ERECTUS Van Duzee

Frequent: season June 8 to September 7; has been taken on *Hypericum prolificum* and *Psedera quinquefolia*. P. I.

## PHYTOCORIS BREVIUSCULUS Reuter

Washington, D. C., July 2, 9, 1926, at light, Knight.

## PHYTOCORIS JUNIPERICOLA Knight

Washington, D. C., July 19, 25, August 6, 1926, on red cedar; Glen Echo, Md., July 17, 1926, Knight; Plummer Island, Md., August 3, 1915, R. C. Shannon and V. A. Roberts.

## PHYTOCORIS MUNDUS Reuter

Common on *Pinus virginiana*, season June 4 to October 12; comes to light. P. I.

## PHYTOCORIS CONSPERSIPES Reuter

Abundant on *Pinus virginiana*; June 8 to November 1. P. I.

## PHYTOCORIS UNIFORMIS Knight

Beltsville, Md., June 23, 1918, McAtee, Vienna, Va., July 7, 11, 1926, on pine, Knight.

## PHYTOCORIS QUERCICOLA Knight

Beltsville, Md., July 4, 1915; June 23, 1918, on *Quercus alba*, McAtee; Glen Echo, Md., July 1, 1923, J. R. Malloch.

**PHYTOCORIS TIBIALIS Reuter**

Common, April 19 to October 12. P. I.

**PHYTOCORIS CONFLUENS Reuter**

Frequent on hickory; season June 15 to October 4. P. I.

**PHYTOCORIS PUELLA Reuter**

Common; June 9 to October 24; occurs most often on hickory, but also on oak, maple, and pine; comes to light. P. I.

**PHYTOCORIS VENUSTUS Knight**

Odenton, Md., July 29, 1917, on wild grape; August 14, 1918, McAtee.

**PHYTOCORIS INFUSCATUS Reuter**

Frequent; season June 14 to July 27; has been taken on walnut.

**PHYTOCORIS OLSENI Knight**

Mount Vernon, Va., June 6, 1915, McAtee.

**Genus PARAXENETUS Reuter****PARAXENETUS GUTTULATUS Uhler**

Fairly numerous; season June 7 to September 13; frequently taken on foliage of the tulip tree, sometimes on grape vines. P. I.

**BIBLIOGRAPHY****BANKS, NATHAN.**

Rare Hemiptera in Virginia. Ent. News, vol. 18, 1907, p. 425.

*Eucerochoris* (now *Paraxenetus*) *guttulatus* on foliage of tulip tree. Catalogue of the Nearctic Hemiptera-Heteroptera. American Ent. Soc., Philadelphia, 1910, pp. 103+viii.

Records several species of Miridae from the District of Columbia. At the Ceanothus in Virginia. Ent. News, vol. 23, 1912, pp. 102-110.

Seven species of Miridae recorded (p. 105); the name *Lygus fusconotatus* is an error for *L. flavonotatus* Provancher, a synonym of *pratensis* Linnaeus.

**BLATCHLEY, W. S.**

Heteroptera or true bugs of Eastern North America, 1926, 1116 pp., 215 figs.

Records numerous species from our area.

**HEIDEMANN, OTTO.**

Note on the occurrence of a rare Capsid, near Washington, D. C. Proc. Ent. Soc. Wash., vol. 2, 1891, pp. 68-69.

*Cylapus tenuicornis* Say is recorded for the first time.

Note on the food-plants of some Capsidae from the vicinity of Washington, D. C. Proc. Ent. Soc. Wash., vol. 2, 1892, pp. 224-226.

Twenty species are mentioned, 10 under Uhler manuscript names while 4 others are misidentifications. Of the Uhler names some are accompanied by descriptive matter sufficient to validate them. Five of them are identifiable and are accepted in the present paper.

HEIDEMANN, OTTO.—Continued.

Heteroptera found on ox-eye daisy (*Chrysanthemum leucanthemum*), Proc. Ent. Soc. Wash., vol. 4, p. 217, May 1899.

Twelve species of Miridae are included in the list, one of them under a manuscript name, *Apocremnus robustus* Uhler.

[Notes on some hemipterous insects.]

Proc. Ent. Soc. Wash., vol. 12, 1910, pp. 45-57.

Records the rearing of *Eurychiloptercella luridula* Reuter from the District of Columbia; also the first specimen of a *Sericophanus* (*S. heidemannii* Poppius then undescribed) from Plummer Island, Md.

KNIGHT, HARRY H.

A revision of the genus *Lygus* as it occurs in America north of Mexico, with biological data on the species from New York. N. Y. (Cornell) Agr. Expt. Sta., Bull. 391, 1917, pp. 555-645.

Records nine species of *Lygus* from local material, four of which are described as new.

New species of Lopidea (Miridae, Hemiptera). Ent. News, vol. 28, 1917, pp. 455-461.

Four new species, *Lopidea heidemannii*, *L. davisii*, *L. reuteri*, and *L. staphyltcae* described in part from local material.

Old and new species of Lopidea from the United States (Hemiptera, Miridae). Ent. News, vol. 29, 1918, pp. 210-216.

Four species recorded, and *Lopidea sayi* described in part, from Plummer Island.

New and little-known species of Phytocoris from the eastern United States (Hemiptera-Miridae). Bull. Brooklyn Ent. Soc., vol. 15, 1920, pp. 49-66.

Three new species of *Phytocoris* described in part from local material while two others are recorded.

Monograph of the North American species of Deraeocoris (Heteroptera, Miridae). 18th Rep. State Ent. Minnesota, for 1920 (1921), pp. 76-210. pls. viii-ix, 44 figs. Reprinted as Tech. Bull. No. 1, Univ. Minn. Agr. Exp. Sta., 1921, pp. 76-210.

Records nine species of Deraeocoris from our region, of which four species are described in part from local material. Two new names are proposed, *nitcunatus* for the preoccupied *nitens* Reuter, and *nigritulus* for *nigritus* Reuter. The name *cunatus* proposed on p. 96 for one of our local species is preoccupied by *pocellus* (Reuter ms.) McAtee.

The Miridae (or Capsidae) of Connecticut. In Hemiptera of Connecticut. Conn. Geol. Nat. Hist. Surv., Bull. 34, 1923, pp. 422-658, figs. 47-149.

Ten new species and 3 new varieties are described in part from local material, while some 20 other species are described which are now found in our area.

A new Peritropis from the Eastern United States (Heteroptera, Miridae). Ent. News, vol. 34, 1923, pp. 50-52.

Refers to *P. saldaeformis* from Washington, D. C.

Descriptions of six new Miridae from Eastern North America (Hemiptera, Miridae). Can. Ent., vol. 58, 1926, pp. 252-256.

*Plagiognathus tilliae* is described in part from District of Columbia material.

KNIGHT, HARRY H.—Continued.

A key to the North American species of *Macrolophus*, with descriptions of two new species. (Hemiptera, Miridae.) Ent. News, vol. 37, 1926, pp. 313-316.

*Macrolophus separatus* Uhler recorded and *M. brevicornis* described in part from local material.

Notes on the distribution and host plants of some North American Miridae (Hemiptera). Can. Ent., vol. 59, 1927, pp. 34-44.

*Atepidiella heidemanni* Poppins found breeding on *Pinus virginiana*, *Philophorus walshii* Uhler breeding on *Gleditsia triacanthos*, while *Criocoris saliens* Reuter and *Phytocoris brevisculus* Reuter are recorded from local material.

Descriptions of 12 new species of Miridae from the District of Columbia and vicinity (Hemiptera). Proc. Biol. Soc. Wash., vol. 40, 1927, pp. 9-18.

Twelve species and two new varieties are described from our region.

Descriptions of 15 new species of *Ceratocapsus* (Hemiptera, Miridae). Ohio Journ. Sci., vol. 27, 1927, pp. 143-154.

Three new species, *Ceratocapsus uniformis*, *barbatus*, and *mcateeii* are described from local material.

Key to the species of *Oncrometopus* with descriptions of five new species (Hemiptera, Miridae).

Journ. N. Y. Ent. Soc., 36, No. 2, June 1928 (August), pp. 189-194.  
*O. nitens* new species described in part from local material.

MCÁTEE, W. L.

Psyllidae wintering on conifers about Washington, D. C., Science, new ser., vol. 41, p. 940, June 1915.

*Lygus pratensis* hibernating on pine.

Key to the Nearctic species of *Paracalocoris* (Heteroptera, Miridae). Ann. Ent. Soc. Amer., vol. 9, 1916, pp. 366-390.

Records from our region 5 species, 1 of which is described as new and 11 varieties, 10 new.

A sketch of the Natural History of the District of Columbia, Bull. Biol. Soc. Wash., 1, 1918, 142 pp., 4 maps.

Refers to collecting localities for a few of the rarer Mirids.

Notes on two Miridae, *Camptobrochis* and *Paracalocoris* (Heteroptera). Ent. News, vol. 30, 1919, pp. 246-247.

*Camptobrochis pocillus* validated and becomes available for the pre-occupied name, *cunialis* Reuter, originally described as a variety from the District of Columbia material; notes on *C. nebulosus* also.

MCÁTEE, W. L., and MALLOCH, J. R.

Some annectant bugs of the super-family Cimicoidea (Heteroptera), Bull. Brooklyn Ent. Soc., vol. 19, pp. 63-82, Pl. 1, June, 1924.

*Peritropis saldaeformis* Uhler recorded (p. 73).

POPPINS, B.

Übersicht der *Pilophorus* arten nebst beschreibung verwandter Gattungen (Hemiptera-Heteroptera). Ann. Soc. Ent. Belgique, vol. 58, 1914, pp. 237-254.

*Pilophorus brunneus*, new species, and *Atepidiella heidemanni*, new genus, new species, founded on local material. *Pilophorus crassipes*, new species, is recorded in part from District of Columbia, but the type was from Colorado and proves to be different, while the local specimens are referable to *P. crassipes* Heidemann.



## REUTER, O. M.

Bemerkungen über Nearktische Capsiden nebst beschreibung neuer Arten. Acta Soc. Sci. Fennicae, vol. 36, No. 2, 1909, pp. 1-86.

There are recorded from our territory, 31 species and 5 varieties of which 16 species and 5 varieties besides 2 new genera are described, wholly or in part, from local material. One of the species, *Phytocoris subnitidulus*, is now regarded as a synonym of *P. fumatus*. Two other species had names preoccupied and have since been renamed as follows: *Camptobrochis nigrita* becomes *Deracocoris nigritulus* Knight, while *Camptobrochis nitens* becomes *Deracocoris nitentulus* Knight. The record for *Camptobrochis grandis* Uhler refers to *Deracocoris aphidiphagus* Knight. *Psallus cuneali* Uhler a ms. name possibly validated here is preoccupied.

## UHLER, P. R.

Observations on some remarkable forms of Capsidae. Proc. Ent. Soc. Wash., vol. 2, 1891, pp. 119-123.

Describes *Peritropis saldaeformis* from local material, also records the finding of *Cyrtapus tenuicornis* Say by Heidemann.

Observations on some remarkable Heteroptera of North America. Trans. Maryland Acad. Sci., 1892, pp. 179-184.

Records *Hadrodema pulverulenta*, new species=*Lygus rubicundus* Fallen, from Washington.

List of Hemiptera-Heteroptera of Las Vegas Hot Springs, New Mexico, collected by Messrs. E. A. Schwarz and Herbert S. Barber. Proc. U. S. Nat. Mus., vol. 27, No. 1360, 1904, pp. 349-364.

Describes *Dichroöcytus elegans* in part from Washington, D. C., but these eastern specimens have been shown to belong to a different species, namely *Dichroöcytus tinctipennis* Knight.

## VAN DUZEE, E. P.

Monograph of the North American species of *Orthotylus* (Hemiptera). Proc. Calif. Acad. Sci., vol. 6 (ser. 4), 1916, pp. 87-128.

Records *O. flavosparsus* Sahlberg and *chlorionis* Say from our region Catalogue of the Hemiptera of America north of Mexico excepting the Aphididae, Coccidae and Aleurodidae. Univ. Calif. Publ., Div. Ent., Tech. Bul., vol. 2, 1917, pp. 1-902.

Records several species of Miridae from the District of Columbia.

New species of Hemiptera chiefly from California. Proc. Calif. Acad. Sci. (ser. 4), vol. 8, 1918, pp. 271-308.

Describes *Pilophorus lactus* and *P. crassipes*, in part from local material, but the name *crassipes* had previously been published for the same species by Heidemann.



DISTRIBUTION AND KEY OF THE NORTH AMERICAN  
COPEPODS OF THE GENUS DIAPTOMUS, WITH THE  
DESCRIPTION OF A NEW SPECIES

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Since the publication of the "Revision of the North American Species of Diaptomus" in the Transactions of the Wisconsin Academy of Sciences, Arts, and Letters by Marsh in 1907, there have been many collections of material containing Diaptomi in various parts of North America and quite a number of publications have been issued by several investigators. There has been no other publication covering the genus as a whole except the synopsis by Marsh in Ward and Whipple's Fresh-Water Biology, and Tollinger's paper on distribution published in 1911.

In addition to the published material, the author has accumulated many data from collections belonging to the United States National Museum, and others which have been sent to him, and from numerous collections made by him personally. It is thought that a paper covering the present knowledge of the distribution of the species would be helpful to others.

It is understood, of course, that such a paper gives only the known distribution. In spite of the considerable number of collectors, only limited portions of the country have been studied with anything like thoroughness. Most of the collections have been of a sporadic character, sometimes in only one or two localities in a State; very few collections have been made in the whole region of Canada, and Mexico is almost an unknown territory. While it can ordinarily be assumed that a species is found in the regions intervening between its extreme limits, it can not now be known what the extreme limits are, so that it is probable that the distribution is much wider than is shown by the collections. In the charts, in nearly all cases, the actual places of collections are indicated rather than a region where the species may be found. Perhaps all the locations for such species as *D. oregonensis* and *D. minutus* are not indicated in Wisconsin

where they are widely distributed, but, generally speaking, the symbols represent definite locations where collections have been made.

It may be interesting to note that the species of *Diaptomus* have few variable characteristics. They are morphologically very distinct and maintain this distinctness even when widely separated geographically. Systematists have had little excuse for making varieties of the species of this genus.

It is noticeable, too, that North America has a *Diaptomus* fauna quite distinct from that of the other continents. *D. bacillifer*, which, curiously, has been found in only two localities in America is a common species in Europe and Asia. A variety of *D. eiseni* is said to have been found in Siberia. *D. castor* occurs in Greenland. With the exception of these three species all the North American Diaptomi are peculiar to the Western Hemisphere, and only one North American species has been found in South America.

Without doubt the principal controlling factor in distribution is temperature; while some species can live under a rather wide range of temperature, many of them are distinctly stenothermal.

For the convenience of those caring to make determinations of species a key is given which includes all the species now known. This key is based on the similar key prepared by the author for Ward and Whipple's Fresh-Water Biology with some corrections and additions.

Each species is followed by the date of original publication in order to facilitate reference to the bibliography which accompanies the paper.

DIAGNOSTIC KEY TO THE KNOWN NORTH AMERICAN SPECIES OF DIAPTOMUS

- |  |  |
|--|--|
| 1 (20). Antepenultimate segment of the male right antenna without distinct appendage.....                                    | 2.   |
| 2 (3). Right and left fifth feet of male nearly equal in length, terminal hook of right foot symmetrical.....                | <b>Diaptomus oregonensis</b> Lilljeborg, 1889. |
| 3 (2). Left fifth foot of male shorter than right.....   | 4.   |
| 4 (9). Left fifth foot of male reaching beyond first segment of right exopodite.....   | 5.   |
| 5 (8). Right endopodite of male fifth foot equal in length to first segment of exopodite.....                                | 6.   |
| 6 (7). Terminal hook of second segment of right exopodite denticulate.   | <b>Diaptomus marshi</b> Juday, 1914.           |
| 7 (6). Terminal hook of exopodite of right fifth foot of male uniaangular.   | <b>Diaptomus reighardi</b> Marsh, 1895.        |
| 8 (5). Endopodite of right fifth foot of male longer than first segment of exopodite, terminal hook of right foot biangular. | <b>Diaptomus mississippiensis</b> Marsh, 1894. |
| 9 (4). Left fifth foot of male reaching end of first segment of right exopodite or only slightly exceeding it.....           | 10.  |
| 10 (13). Antepenultimate segment of right antenna of male produced at distal end into a blunt point.....                     | 11.  |

- 11 (12). First segment of right exopodite of male fifth foot with marked quadrangular hyaline appendage.....*Diaptomus birgei* Marsh, 1894.
- 12 (11). First segment of right exopodite of male fifth foot with triangular projection.....*Diaptomus virginianensis* Marsh, 1915.
- 13 (10). Antepenultimate segment of right antenna of male not produced into blunt point on distal end..... 14.
- 14 (15). Inner process of the terminal segment of exopodite of left fifth foot of male falciform, no hyaline appendage on first segment of right exopodite.....*Diaptomus pallidus* Herrick, 1879.
- 15 (14). Inner process of terminal segment of left exopodite of male fifth foot digitiform..... 16.
- 16 (17). Endopodites in both male and female fifth feet two-segmented, a hyaline process on second basal segment of right fifth foot of male.  
*Diaptomus castor* Jurine, 1820.
- 17 (16). Endopodites of both male and female fifth feet one-segmented, or in *D. tyrelli* the left endopodite of the male is sometimes indistinctly two-segmented, a hyaline appendage on inner distal angle of first segment of right exopodite of male fifth foot..... 18.
- 18 (19). Lateral spine of second segment of right exopodite nearly straight; no blunt spine on posterior surface of this segment.  
*Diaptomus tyrelli* Poppe, 1888.
- 19 (18). A second hyaline appendage on dorsal side of distal margin of first segment of right exopodite of male, lateral spine of second segment of right exopodite strongly curved, and a blunt spine on the posterior surface of this segment.....*Diaptomus coloradensis* Marsh, 1911.
- 20 (1). Antepenultimate segment of right antenna of male with lateral lamella or terminal process..... 21.
- 21 (30, 52). Antepenultimate segment of right antenna of male with hyaline lamella..... 22.
- 22 (25). Hyaline lamella broad, extending beyond the end of the segment, second basal segment of right exopodite of male fifth foot armed on the posterior surface with a small hook..... 23.
- 23 (24). In male fifth foot the right endopodite is about one-half as long as the first segment of the exopodite, the left endopodite reaches about the middle of the second segment of the exopodite; in the female fifth foot the exopodite is two-segmented, with two spines representing the third segment; the setae on the endopodites are of ordinary length.  
*Diaptomus leptopus* Forbes, 1882.
- 24 (23). In male fifth foot the right endopodite about equals in length the first segment of the exopodite, the left endopodite nearly reaches the end of the second segment of the exopodite; in female fifth foot the third segment of the exopodite is indistinctly separated, two spines on the third segment and one on the second, the setae of the endopodites are unusually long.....*Diaptomus piscinae* Forbes, 1893.
- 25 (22). Hyaline lamella antepenultimate segment of right antenna of male narrow, extending beyond the end of the segment slightly if at all... 26.
- 26 (27). Second basal segment of right fifth foot of male armed with a hook equal in length to the first segment of the exopodite.  
*Diaptomus clavipes* Schacht, 1897.
- 27 (26). Second basal segment of right fifth foot of male not armed with hook..... 28.
- 28 (29). First segment of exopodite of right fifth foot of male short and broad.  
*Diaptomus gatunensis* Marsh, 1913.

- 29 (28). First segment of exopodite of right fifth foot of male elongate.  
*Diaptomus leonicollinus* Marsh, 1913.
- 30 (21, 52). Antepenultimate segment of right antenna of male bears a slender straight process ----- 31.
- 31 (36, 43). Process much shorter than the penultimate segment ----- 32.
- 32 (35). Right endopodite of male fifth foot rudimentary ----- 33.
- 33 (34). Lateral spine of second segment of right exopodite of male fifth foot terminal ----- *Diaptomus lintoni* Forbes, 1893.
- 34 (33). Lateral spine of second segment of right exopodite of male fifth foot nearer the proximal end of the segment.  
*Diaptomus trybomi* Lilljeborg, 1889.
- 35 (32). Right endopodite of male fifth foot about equal in length to the first segment of the exopodite; lateral spine of second segment of the exopodite located near the center of the segment. First segment of the female abdomen has a process extending backward from the posterior margin of the right side ----- *Diaptomus judayi* Marsh, 1907.
- 36 (31, 43). Process nearly or fully equals penultimate segment ----- 37.
- 37 (38). Right endopodite of male fifth foot equals in length first segment of exopodite, spines of first basal segments large.  
*Diaptomus tenuicaudatus* Marsh, 1907.
- 38 (37). Right endopodite of male fifth foot exceeds length of first segment of exopodite, spines of first basal segments small ----- 39.
- 39 (40). Endopodites of male fifth feet two segmented.  
*Diaptomus arcticus* Marsh, 1920.
- 40 (39). Endopodites of male fifth feet one segmented ----- 41.
- 41 (42). Inner process of terminal segment of left fifth foot of male falciform.  
*Diaptomus bacillifer* Kölbel, 1884.
- 42 (41). Inner process of terminal segment of left fifth foot of male digitate.  
*Diaptomus sicilis* Forbes, 1882.
- 43 (31, 36). Process exceeds in length penultimate segment ----- 44.
- 44 (49). Lateral spine of second segment of exopodite of right fifth foot of male terminal or nearly so, antennae reach proximal end of furca ----- 45.
- 45 (46). Process of antepenultimate segment of right antenna of male only slightly longer than penultimate segment, antennae equal in length to cephalothorax ----- *Diaptomus shoshone* Forbes, 1893.
- 46 (45). Antennal process of male exceeds ultimate segment, antennae reach furca ----- 47.
- 47 (48). Endopodites of male fifth clavate, a small tooth about midway of inner border of second segment of the exopodites of the female fifth feet ----- *Diaptomus augustaensis* Turner, 1910.
- 48 (47). Endopodites of male fifth feet slender and straight, no tooth on inner border of second segment of exopodite of female fifth foot.  
*Diaptomus wardi* Pearse, 1905.
- 49 (44). Lateral spine of second segment of right exopodite of male fifth foot on proximal half of segment, antennae reach beyond furca ----- 50.
- 50 (51). Lateral spine of second segment of right exopodite of male fifth foot short, right endopodite rudimentary, endopodites of female fifth feet rudimentary ----- *Diaptomus minutus* Lilljeborg, 1889.
- 51 (50). Lateral spine of second segment of right exopodite of male fifth foot long, right endopodite equals in length first segment of exopodite.  
*Diaptomus ashlandi* Marsh, 1893.

- 52 (21, 30). Antepenultimate segment of right antenna of male bears curved process ----- 53.
- 53 (58). Process equals or exceeds in length penultimate segment ----- 54.
- 54 (55). Process about equals in length last two segments, second basal segment of right fifth foot of male dilated on inner margin, endopodites of fifth feet in both sexes indistinctly two-segmented.  
*Diaptomus eiseni* Lilljeborg, 1889.
- 55 (54). Process slightly exceeds in length penultimate segment ----- 56.
- 56 (57). Appendage of antepenultimate segment of male antenna broad, in male fifth foot outline of second segment of right exopodite convex, with lateral spine nearly terminal, terminal hook sinuate.  
*Diaptomus franciscanus* Lilljeborg, 1889.
- 57 (56). Appendage of antepenultimate segment of male antenna slender, in male fifth foot outline of second segment of right exopodite biconcave, lateral spine distad of center of segment, terminal hook symmetrical.  
*Diaptomus mexicanus*, new species.
- 58 (53). Process shorter than penultimate segment ----- 59.
- 59 (70, 73). One or both terminal processes of last segment of left exopodite of male fifth foot distinctly falciform ----- 60.
- 60 (67). Right endopodite of fifth foot of male small, shorter than first segment of exopodite ----- 61.
- 61 (64). In right fifth foot of male the terminal segment of the exopodite is slender and elongate; the terminal hook is stout; the endopodite is rudimentary ----- 62.
- 62 (63). The lateral spine long and slender; the left endopodite is spatulate.  
*Diaptomus spatulocrenatus* Pearse, 1906.
- 63 (62). Lateral spine stout; left endopodite long and slender.  
*Diaptomus conipedatus* Marsh, 1907.
- 64 (61). Terminal segment of right exopodite of male is of usual proportions; the terminal hook is not markedly broad; the endopodite is distinct ----- 65.
- 65 (66). Left fifth foot of male reaches end of second basal segment of right foot, lateral spine of second segment of right exopodite at about two-thirds its length ----- *Diaptomus sanguineus* Forbes, 1876.
- 66 (65). Left fifth foot of male exceeds second basal segment of right foot, lateral spine of second segment of exopodite nearly terminal, dorsal process on fifth cephalothoracic segment of female.  
*Diaptomus saltillinus* Brewer, 1898.
- 67 (60). Right endopodite of fifth foot of male distinctly longer than first segment of exopodite ----- 68.
- 68 (69). First segment of right exopodite of male fifth foot has transverse ridge on the posterior surface, the lateral spine of the second segment is about one-half as long as the segment, the first segment of the female abdomen has a prominent swelling on the right side.  
*Diaptomus asymmetricus* Marsh, 1907.
- 69 (68). First segment of right exopodite of male fifth foot has two curved processes on posterior side, the lateral spine of the second segment equals or exceeds in length the segment, the fifth cephalothoracic segment of the female is armed with two dorsal processes.  
*Diaptomus dorsalis*, Marsh, 1907.
- 70 (59, 73). One of the terminal processes of the left exopodite of male is a straight or nearly straight sharp spine ----- 71.

- 71 (72). In male fifth feet the lateral spine of the second segment of the right exopodite is short, one-third the length of the segment, the terminal hook is broad and saber-like, the left endopodite is marked with transverse striae; the endopodites of the female fifth feet are two-segmented-----*Diaptomus stagnalis* Forbes, 1882.
- 72 (71). In male fifth feet the lateral spine of the second segment of the right exopodite is long, equaling in length the two segments of the exopodite, the terminal hook is long and slender, the left endopodite is not marked with transverse striae; the endopodites of the female fifth feet are one-segmented-----*Diaptomus floridanus* Marsh, 1926.
- 73 (59, 70). Terminal processes of left exopodite of fifth feet of male are digitiform ----- 74.
- 74 (78). The right endopodite of the male fifth foot equals or exceeds the first segment of the exopodite----- 75.
- 75 (76, 77). The endopodites of the fifth feet of male are one-segmented.  
*Diaptomus novamexicanus* Herrick, 1895.
- 76 (75, 77). In both male and female fifth feet the endopodites are two-segmented. The exopodites of the female fifth feet are three-segmented.  
*Diaptomus bakeri* Marsh, 1907.
- 77 (75, 76). In male fifth feet, right endopodite two-segmented, left one-segmented, first segment of female abdomen has a digitiform process on right distal border-----*Diaptomus washingtonensis* Marsh, 1907.
- 78 (74). Right endopodite of male fifth foot shorter than first segment of exopodite ----- 79.
- 79 (80, 83). In male fifth feet, second basal segment and first segment of exopodite of right foot without hyaline appendages, lateral spine of second segment of exopodite nearer proximal end of segment.  
*Diaptomus nudus* Marsh, 1904.
- 80 (79, 83). In male fifth feet a hyaline appendage on first segment of right exopodite ----- 81.
- 81 (82). In male fifth feet a hyaline appendage on inner distal angle of first segment of right exopodite, right endopodite nearly equal in length to first segment of exopodite, digitiform process on right distal margin of female abdomen-----*Diaptomus signicauda* Lilljeborg, 1889.
- 82 (81). In male fifth feet a quadrangular hyaline appendage on inner distal half of first segment of right exopodite, right endopodite much shorter than the first segment of the exopodite.  
*Diaptomus siciloides* Lilljeborg, 1889.
- 83 (79, 80). In male fifth feet second basal segment of right foot with one or hyaline appendages, an oblique ridge on the posterior surface of the second segment of the right exopodite----- 84.
- 84 (85). In male fifth feet the lateral spine of the second segment of the right exopodite equals in length the segment, there is a dorsal process on the fifth cephalothoracic segment of the female.  
*Diaptomus albuquerquensis* Herrick, 1895.
- 85 (84). In male fifth feet the lateral spine of the second segment of the right exopodite equals in length one-half of the segment, there is no dorsal process on the fifth cephalothoracic segment of the female.  
*Diaptomus purpureus* Marsh, 1907.

*DIAPTOMUS ALBUQUERQUENSIS* Herrick, 1895

*D. lehmeri* Pearse 1904 is *D. albuquerquensis* of Herrick published in 1895. *D. albuquerquensis* Schacht 1897 is *D. floridanus* Marsh.



*D. albuquerqueensis* was first found, as the name indicates, in New Mexico. It has been collected at various places in eastern Colorado by Dodds 1915a, 1917, 1920, and 1924, and by the author, and was reported by Juday 1915 from Lake Amatitlan, Guatemala, and from Mexico City. Its distribution is shown in Figure 1.

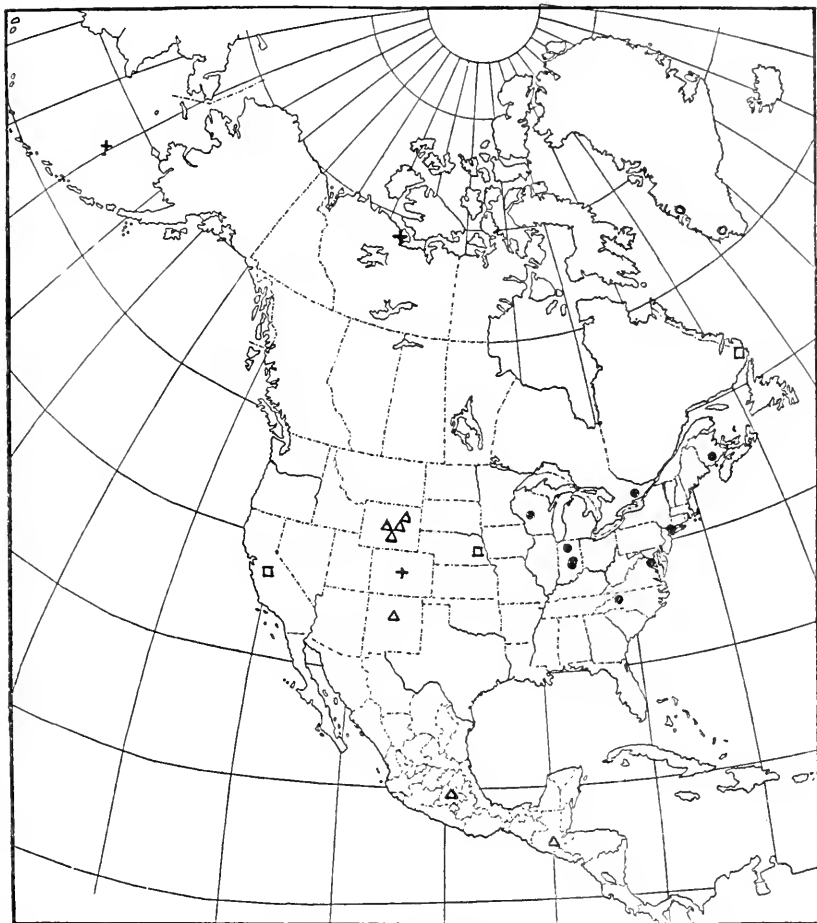


FIGURE 1.—DISTRIBUTION OF *DIAPTOMUS ALBUQUERQUENSIS* HERRICK ( $\Delta$ ), *D. BACILLIFER* KÖLBEL, (+), *D. BIRGEI* MARSH ( $\bullet$ ), *D. CASTOR* JURINE ( $\square$ ), AND *D. EISNERI* LILLJEBORG ( $\odot$ )

#### DIAPTOMUS ARCTICUS Marsh, 1920

*D. arcticus* was named from material collected by Frits Johansen on Herschel Island, and up to this time has been found in no other locality.

#### DIAPTOMUS ASHLANDI Marsh, 1893

*D. ashlandi* occurs in the Great Lakes, in Round Lake, and Pine Lake, in Michigan, these lakes being connected with Lake Michigan;

in Yellowstone Lake, in Flathead Lake, Mont.; in Lake Pend d'Oreille, Idaho; in Washington Lake, Seattle; and has been reported by Schacht, 1897, in Indiana and Oregon. Its distribution is shown in Figure 2.

**DIAPTOMUS ASYMMETRICUS** Marsh, 1907

This species has been reported only from Habana, Cuba, in a collection sent by Prof. C. F. Baker.

**DIAPTOMUS AUGUSTAENSIS**, Turner, 1910

Turner's original description of his material, from a temporary pond in a marsh at Augusta, Ga., constitutes the only known record of this species.



FIGURE 2.—DISTRIBUTION OF *DIAPTOMUS ASHLANDI* MARSH (●), *D. CLAVIPES* SCHACHT (+), *D. DORSALIS* MARSH (□), AND *D. LEPTOPUS* FORBES (○)

**DIAPTOMUS BACILLIFER** Kölbel, 1884

The distribution of *D. bacillifer* in North America is shown in Figure 1. It was first found in America in collections made by Frits Johansen at Bernard Harbor on the Arctic coast of Canada, March, 1920, and later in collections made by Professor Parker on St. Paul Island, off Alaska. An examination of the description of a species found in the mountains of Colorado by Dodds 1915*b*, and called by him *D. arapahoensis*, makes it evident that this is *D. bacillifer*.

This species is found in many localities in northern Europe and Asia, in the islands north of Siberia, and in the mountains of southern Europe and central Asia. It is a stenothermal form confined to the colder waters. While it has been found in America in only the three localities, and those far apart, it is probable that further collec-

tions will show its presence in other localities in northern Canada and at high altitudes farther south. The occurrence of this species in America is of special interest, as it is the first instance of a species of *Diaptomus* being found in both the Eurasian and American continents.

**DIAPTOMUS BAKERI** Marsh, 1907

*D. bakeri* has been found in only two localities, both in the State of California, Stanford University and Monterey.

**DIAPTOMUS BIRGEI** Marsh, 1894

*D. birgei* was first found near New Lisbon, Wis. Since the original description in 1894 it has been found in Eagle Lake, near Warsaw, Ind.; in Richmond, Ind.; Cold Spring Harbor, on Long Island; several localities in the immediate vicinity of Washington, D. C.; by Coker, 1926, in lakes at the headwaters of the Catawba, N. C., and has been reported by Klugh, 1926, at Barriefield, Ontario, and St. Andrews, New Brunswick. The distribution is shown in Figure 1.

**DIAPTOMUS (MONOCULUS) CASTOR** Jurine, 1820

*D. castor* is widely distributed in Europe and has been reported by Stephenson, 1913, and Haberbosch, 1920, on the western coast of Greenland. Its distribution is shown in Figure 1. It does not occur on the continent of America.

**DIAPTOMUS CLAVIPES** Schacht, 1897

This species was first described from material collected in the Okoboji Lakes in northwestern Iowa. Brewer, 1898, found it in temporary pools in Nebraska, calling it *D. nebraskensis*. Beardsley, 1902, reported it from Greeley, Colo. The author found it at Hugo, Colo., and in lakes near Pikes Peak, in the same State. Dodds, 1908, 1915a, 1917, 1920, 1924, reported it from La Junta and several other localities in Colorado. A letter to the author from C. I. Alexander stated that he had found it near Fort Worth, Tex. The distribution is shown in Figure 2.

**DIAPTOMUS COLORADENSIS** Marsh, 1911

*D. coloradensis* was originally described from material collected at Mount Carbon, Kremmling, Corona, and Tolland, Colo. It occurred in a number of small bodies of water near Mount Carbon. Later it was repeatedly found by the author near the Salina Experiment Station of the United States Department of Agriculture in Utah, and in the summer of 1928 it was found in the lake at Palisade Park, about 6 miles south of Manti, Utah. All of these locations except the last are 8,000 feet or more in altitude; Palisade Park is 5,900 feet. It

is a matter of considerable interest that its altitudinal distribution is so restricted. It has been collected at different times from June until late in September. Its distribution is shown in Figure 7.

**DIAPTOMUS CONIPEATUS Marsh, 1907**

*D. conipedatus* has been found in only one locality—Slidell, La.

**DIAPTOMUS DORSALIS Marsh, 1907**

*D. dorsalis* has been found only in the States of Florida and Louisiana. In Florida it occurred in Little Lake George, Lake Monroe, Middle Lake, and the St. Johns River. In Louisiana it has been found at Slidell and Guzman. Its distribution is shown in Figure 2. It is probable that it will be found in other States bordering on the Gulf of Mexico.

**DIAPTOMUS EISENI Lilljeborg, 1889**

The distribution of *D. eiseni* is shown in Figure 1. It was originally found near Fresno in California. Brewer in 1898 reported it from Lincoln, Nebr. Cushman in 1908 found it at Battle Harbor, Labrador. In 1922 Rylov found what he considers a variety of *D. eiseni* and which he has named *D. eiseni* var. *orientalis* in Siberia. This is a remarkable distribution, the three localities in America being about as far apart as they could be and be on the continent, and the fourth locality being on the opposite side of the world.

**DIAPTOMUS FLORIDANUS Marsh, 1926**

*D. floridanus* has been found only in Florida, in ponds in Polk County.

**DIAPTOMUS FRANCISCANUS Lilljeborg, 1889**

In the original description of this species by DeGuerne and Richard, it is stated that it was common in the neighborhood of San Francisco, Calif. It has not been reported in any other locality.

**DIAPTOMUS GATUNENSIS Marsh, 1913**

*D. gatunensis* was first found in the Panama Canal Zone, in the "Black Swamp" near the old line of the Panama Railroad, and in a pond at Bohio. Dodds later reported it in several localities in the Canal Zone.

**DIAPTOMUS JUDAYI Marsh, 1907**

*D. judayi* has been found in only one locality, Twin Lakes, in the Rocky Mountains of Colorado.

**DIAPTOMUS LEONINICOLLINUS** Marsh, 1913

*D. leoninicollinus* has been found only near Lion Hill in the Panama Canal Zone.

**DIAPTOMUS LEPTOPUS** Forbes, 1882

*D. leptopus* was found by Forbes near Normal, Ill., and at Woods Hole, Mass. Herrick and Turner 1895 reported it from Minnesota. Pearse 1906 found it at Cambridge, Medford, and Wellesley, Mass. Stromsten 1920 found it in the Okoboji region in Iowa. The author has found it near Ripon, Wis., at Marquette, Mich., at Hammond and Gary, Ind., at Kremmling, Colo., and in Panguitch Lake in southern Utah. Juday in correspondence states that he has found it in Devils Lake, N. Dak. Its distribution is shown in Figure 2.

**DIAPTOMUS LINTONI** Forbes, 1893

Forbes' original description of *D. lintoni* was from material collected in the lakes of Yellowstone Park. Dodds 1915*a*, 1915*b*, 1917, found it near Tolland, Colo., and the author found it in Buffalo Horn Lake in the Gallatin Valley, Mont., and in material collected by Prof. Chancey Juday in Laguna Canyon, Calif. Its distribution is shown in Figure 8.

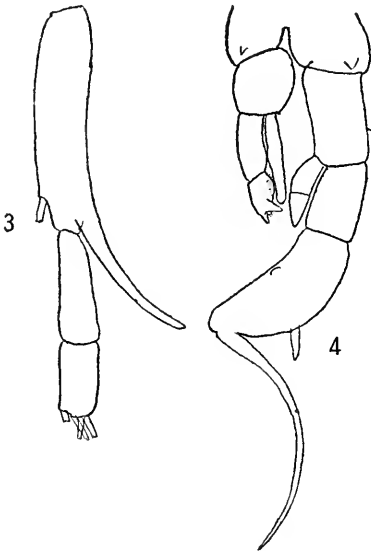
**DIAPTOMUS MARSHI** Juday, 1914

Juday's original description was from collections made at Puerto Barrios and Los Amates, Guatamala. The author found it in the Comacho and Mindi Reservoirs and the Rio Trinidad in the Canal Zone, and in collections made by F. J. Dyer at La Ceiba, Honduras. Pearse 1915 collected it at Fundacio, Colombia. *D. colombiensis* Thiebaud 1914, found in Laguna de Ubaque, Colombia, is *D. marshi*. Dodds 1926 reported it in several localities in the Canal Zone. Its distribution is shown in Figure 6.

**DIAPTOMUS MEXICANUS**, new species

Many years ago a single specimen of a *Diaptomus* was found in a collection made by Rev. C. D. Campbell near Mexico City. The specimen was a mature male evidently allied to *D. franciscanus* Lilljeborg, but with characteristics which clearly distinguished it from that species. Of course, a new species should be founded on a considerable number of individuals; therefore the notes on this animal were kept in readiness for use when further material should come to hand. In spite of a generation or so of delay, the creature has not again shown up. It is, however, so distinctly different from others that it seems wise to give it a name. Very little collecting of Copepoda has been done in Mexico, and it seems highly probable that others may find it later.

The descriptive notes which follow apply, of course, only to the male. Length, 1.2 mm. The antennæ do not quite reach the furca. The furca is ciliated on the inner margins. The antepenultimate segment of the right antenna has a slender, curved appendage which slightly exceeds in length the penultimate segment, Figure 3. The first basal segments of the fifth foot, Figure 4, have rather large spines. The second basal segment of the right foot is quadrangular, its length about twice its width. The first segment of the right



FIGURES 3-4.—3, *DIAPTOMUS MEXICANUS*, NEW SPECIES, TERMINAL SEGMENTS OF RIGHT ANTENNA OF MALE;  $\times 607$ . 4, *DIAPTOMUS MEXICANUS*, NEW SPECIES, FIFTH RIGHT FOOT OF MALE;  $\times 307$

exopodite is also quadrangular and is about four-fifths as long as the second basal segment; the second segment is about twice as long as the first, is strongly curved outwardly, and has the lateral spine distad of the middle of the segment, while opposite the spine, near the inner margin, there is a small cuticular protuberance on the posterior surface; the terminal hook is symmetrically curved and its length equals that of the exopodite and second basal segment combined. The right endopodite is broad, pointed, two-segmented, and reaches the end of the first segment of the exopodite. The left fifth foot about reaches the end of the first segment of the right exopodite; the terminal segment is setose on the inner margin and bears two digitate processes; the endopodite

is slender, one-segmented, and is nearly as long as the two segments of the exopodite.

#### *DIAPTOMUS MINUTUS* Lilljeborg, 1889

*Diaptomus minutus* was described from collections made in Greenland and at St. Johns, Newfoundland. DeGuerne and Richard, 1892, reported it from Iceland. Marsh found it in many lakes in Wisconsin and northern Michigan. It occurs in the Great Lakes, the Finger Lakes of central New York, and in two localities in Maine. It has been found at Dalhousie, New Brunswick, was reported by Willey from the Shubenacadie River, Nova Scotia, and occurred in collections made by Professor Mackay from Nipigon Lake. While it is a very abundant species in the regions where it is found, it is, so far as the continent of North America is concerned, somewhat

limited in its distribution. With the exception of a single specimen reported by Schacht from the Yellowstone National Park it does not occur west of Wisconsin, nor south of the southern borders of Wisconsin, Michigan, and New York, except in Lake Maxinkuckee in northern Indiana. New Brunswick and Lake Nipigon limit its continental distribution in the north. It is typically a cold-water form and in the more southern parts of its range is largely confined to the deeper lakes. Its distribution is shown in Figure 5.

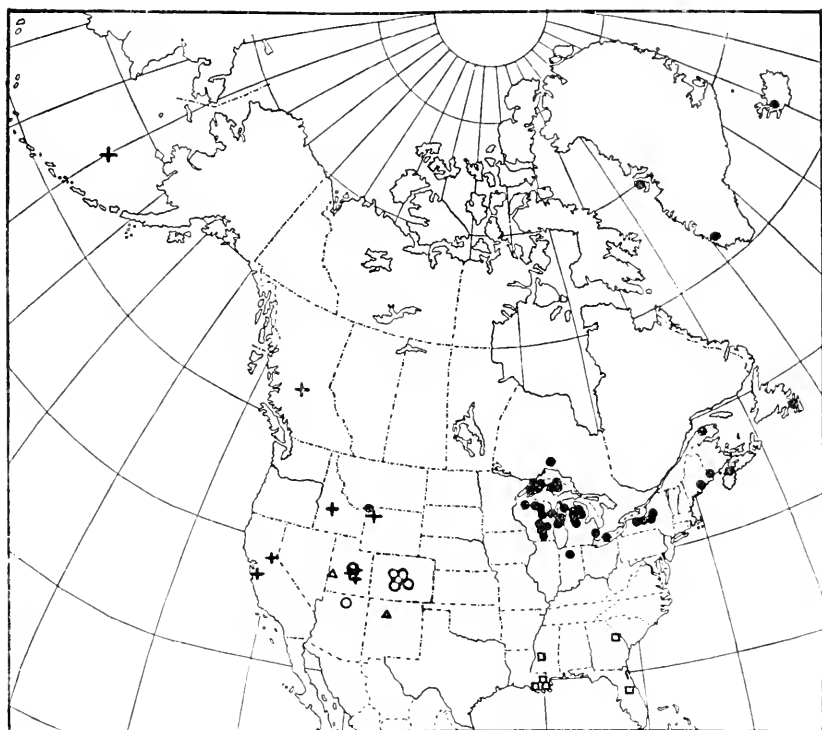


FIGURE 5.—DISTRIBUTION OF *DIAPTOMUS MINUTUS* LILLJEBORG (●), *D. MISSISSIPPIENSIS* MARSH (□), *D. NOVAMEXICANUS* HERICK (△), *D. NUDUS* MARSH (○), AND *D. TYRELLI* POPPE (+)

#### *DIAPTOMUS MISSISSIPPIENSIS* Marsh, 1894

*D. mississippiensis* was described from material collected by Professor Birge at Jackson, Miss.; it was later found in collections made by him at Guzman and Slidell in Louisiana. Turner, 1910, found it at Augusta, Ga., and Schacht, 1897, reported it from Lake Maitland, Fla. Mr. E. Foster has written to the author that he found it in two localities near New Orleans, but not in any numbers. Its distribution is shown in Figure 5.

**DIAPTOMUS NOVAMEXICANUS** Herrick, 1895

*D. novamexicanus* was described by Herrick from material collected at Albuquerque, N. Mex. It has been found in only one other locality—Burbank, Utah. It may be noted that in Herrick's description it was stated that the second segment of the exopodite of the fifth foot of the female bears two spines. In the material examined by the author there has been a third minute spine on this segment in some individuals. The distribution of the species is shown in Figure 5.

**DIAPTOMUS NUDUS** Marsh, 1904

*D. nudus* was described from collections made by Prof. H. B. Ward in lakes in the vicinity of Pikes Peak, Colo.; Dead Lake, Lake Michigan, Lake Rocks, and Mirror Lake. Dodds, 1908, reported it at Boulder, Colo., and in 1915*a* from Tolland, Colo. It has also been found in Colorado, at Kremmling, and in a pond in the city park, Denver. Quite recently it has been collected in Utah Lake, Utah, and in Jacobs Lake in the Kaibab National Forest in Arizona. Its distribution is shown in Figure 5.

**DIAPTOMUS OREGONENSIS** Lilljeborg, 1889

*D. oregonensis* was first found near Portland, Oreg. It has recently been reported by Brehm from Vancouver, British Columbia. It is rather strange that these are the only reports of its occurrence on the Pacific side of the continent. Herrick collected it in Lake Minnetonka, Minn., and it was found in collections made by Doctor Hemingway in Lake Vermilion in northern Minnesota. It occurs in many lakes in Wisconsin and northern Michigan. It is in Lake Superior, Lake Michigan, the Detroit River, and Lake St. Clair and in Lake Erie. Without much doubt it is in Lakes Huron and Ontario, although it has not been reported from them. Stromsten, 1917, found it in the Okoboji Lakes in Iowa. It occurs in northern Illinois and Indiana. Pearse's *pygmaeus*, which is without doubt *oregonensis*, was found in eastern Massachusetts. Klugh, 1926, found it in New Brunswick and the Province of Ontario. Doctor Congdon collected it at Kinistino, Saskatchewan, the most northern point of its known range. In the region of the Great Lakes it is the most common species of the genus. Its distribution is shown in Figure 6.

**DIAPTOMUS PALLIDUS** Herrick, 1879

*D. pallidus* is widely distributed in the general region of the Mississippi Valley. Herrick, in his original description, speaks of it as abounding in the larger lakes of Minnesota and later says that it is in the entire Mississippi Valley. Stromsten, 1917, found it in the Okoboji Lakes and Brewer, 1898, and Pearse, 1905, found it



abundant in eastern Nebraska. It occurs as far west as Pueblo, Colo., and as far south as New Orleans. E. Foster has reported to the writer that it is the most common form near New Orleans, occurring through the year. The most eastern locations are Ohio, where it was found by Turner, and Alabama; there may be some doubt about the Alabama situation—it is based on a statement by

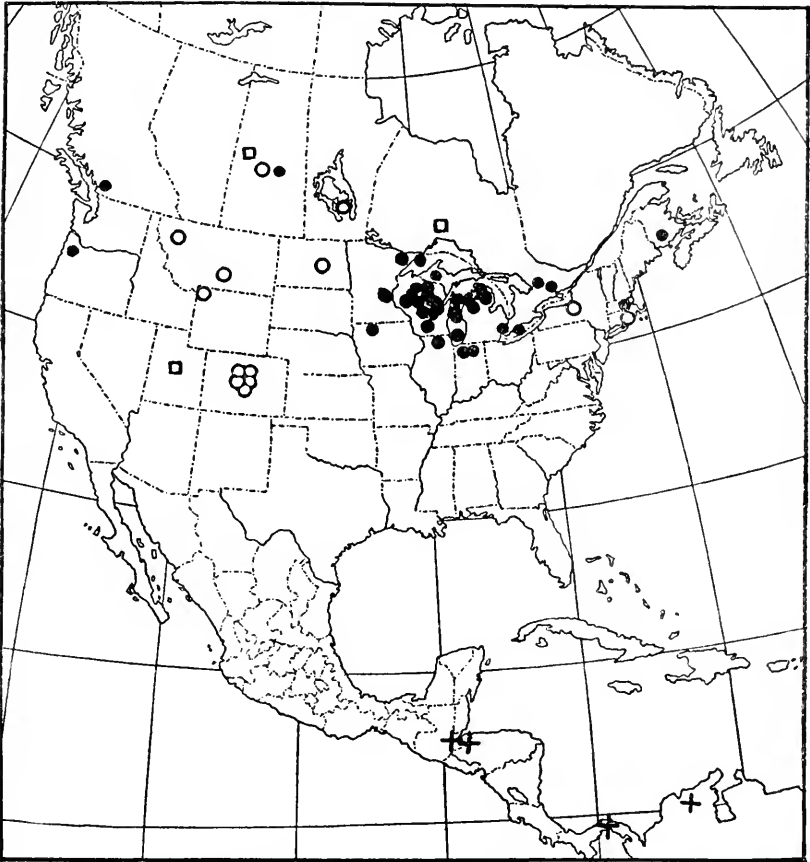


FIGURE 6.—DISTRIBUTION OF *DIAPTOMUS OREGONENSIS* LILLJEBORG (●), *D. MARSHI* JUDAY (+), *D. TENUICAUDATUS* MARSH, (□), AND *D. PISCINAE* FORBES (○)

Herrick that he had found there a form “like *pallidus*.” It is a little strange that it has been found in only one place in Wisconsin, in Heart Lake, Marquette. Its distribution is shown in Figure 8.

#### *DIAPTOMUS PISCINAE* Forbes, 1893

In the paper by Marsh, 1907, *D. piscinae* was considered a variety of *D. leptopus*. Further collections make it probable that the differences which distinguish this from *D. leptopus* are constant, and it

seems desirable to consider it a distinct species. Forbes described the species from material gathered at Gardner, Mont. Schacht, 1897, found it in collections from Portage Slough, Manitoba. Dodds, 1908, 1915*a*, 1915*b*, 1924, found it in Colorado in Red Rock Lake, Boulder, Tolland, and in several lakes in the Pikes Peak region. It has also been found in Colorado at Mount Carbon, in a lake between Kebler Pass and Floresta, and in Twin Lakes. It has been collected in the Birch Hills, Saskatchewan; in Flathead Lake and at Red Lodge in Montana; in Devils Lake, N. Dak.; at Ithaca, N. Y.; and at Woods Hole, Mass. Its distribution is shown in Figure 6. It is noticeable that while, like *D. leptopus*, it occurs in both the East and

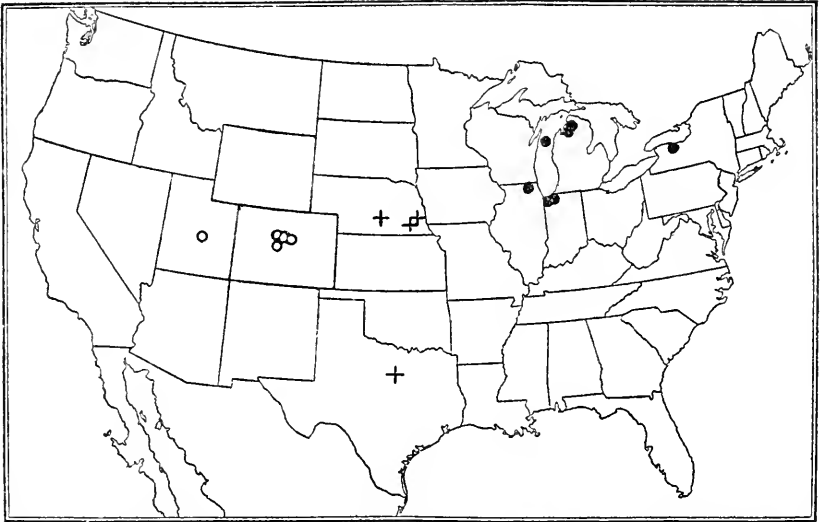


FIGURE 7.—DISTRIBUTION OF *DIAPTOMUS REIGHARDI* MARSH (●), *D. COLORADENSIS* MARSH (○), AND *D. SALTILLINUS* BREWER (+)

West, it has not been collected in the Central States where *D. leptopus* is fairly common.

**DIAPTOMUS PURPUREUS Marsh, 1907**

*D. purpureus* was described from material collected by Prof. C. F. Baker at Habana, Cuba, and no other collections have been made up to the present time.

**DIAPTOMUS REIGHARDI Marsh, 1895**

The original description of *D. reighardi* was made from collections made in Intermediate Lake in northern Michigan. It has since been found in Crooked Lake in northern Michigan; in a lake on Beaver Island in Lake Michigan; at Zion, Ill.; Hammond and Gary, Ind.; and at Sodus Bay, N. Y. Its distribution is shown in Figure 7.

**DIAPTOMUS SALTILLINUS** Brewer, 1898

Brewer described *D. saltillinus* from collections made in the vicinity of Lincoln, Nebr. It was found by Pearse, 1905, in other locations in Nebraska, and Mr. C. I. Alexander has written that he has found it in the neighborhood of Fort Worth, Tex. Its distribution is shown in Figure 7.

**DIAPTOMUS SANGUINEUS** Forbes, 1876

Forbes's description was from material obtained near Normal, Ill., where he said it occurred rather abundantly. Herrick, 1884, found it near Minneapolis, Minn.; Brewer, 1898, reported it in Nebraska;



FIGURE 8.—DISTRIBUTION OF *DIAPTOMUS SANGUINEUS* FORBES (●), *D. PALLIDUS* HERRICK (○), AND *D. LINTONI* FORBES (+)

and Pearse, 1905, reported it in Nebraska and Spokane, Wash. Pearse, 1906, also found it at Wellesley and Medford, Mass. Gissler, 1881, found it at Glendale, Long Island. Herrick reported it in Alabama; and Turner, 1910, from Augusta, Ga. Foster found it near New Orleans, La.; and Stromsten, 1920, in the Okoboji Lakes. It has also been found near Ripon, Wis., and at Saranac Inn, N. Y. It is probable that more complete collections will show that it is common to all the Eastern States. Its distribution is shown in Figure 8.

**DIAPTOMUS SHOSHONE** Forbes, 1893

*D. shoshone* was named from the place where it was first found, Lake Shoshone, in the Yellowstone National Park. Forbes said that

it was found in other lakes in the park and it was later collected there by others. It was in collections made by H. B. Ward in several small lakes near Pikes Peak; by Thacker at Hope, Yale, and Laidlaw, British Columbia; by Young in Devils Lake, N. Dak.; and by Johansen near Toronto, Canada. The writer has collected it at Wheat Meadows in the Sierras, California: at Irwin and Corona, Colo.; and at a number of places in the neighborhood of the Salina Experiment Station, east of Salina, Utah, in the Wasatch Mountains. It was found in a collection made on Vancouver Island and in one

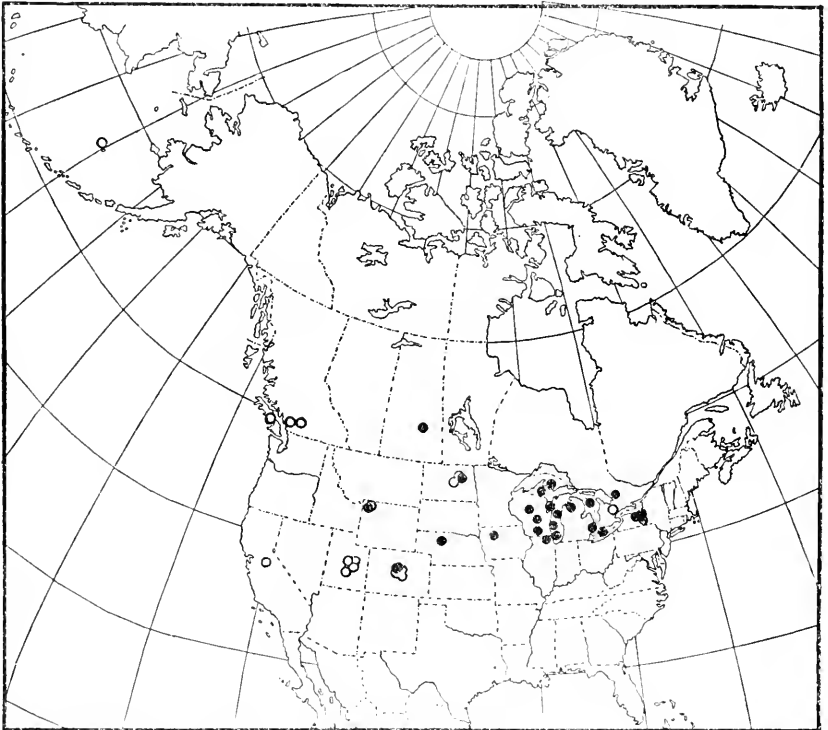


FIGURE 9.—DISTRIBUTION OF *DIAPTOMUS SHOSHONE* FORBES (○), AND *D. SICILIS* FORBES (●)

made in Lake McDonald on St. Paul Island, west of Alaska. Its distribution is shown in Figure 9.

#### **DIAPTOMUS SICILIS** Forbes, 1882

*Diaptomus sicilis* was first found in Lake Michigan, where it is a very common species. It was found in Tomahawk Lake, Green Lake, and Lake Geneva in Wisconsin; in Pine Lake, a lake connected with Lake Michigan in the northern part of the southern peninsula of Michigan; and in Lake Michigamme, in the northern peninsula of Michigan. Forbes, 1891, found it in Lake Superior, Miss H. B.

Merrill collected it in Lake Huron, Reighard in the Detroit River, and Wickliffe in Lake Erie. It occurs in Seneca, Cayuga, and Keuka Lakes, in central New York. Stromsten, 1917, found it in the Okoboji Lakes; Pearse, 1905, in Cherry County, Nebr., and the Muskoka Lakes, Ontario. Beardsley, 1902, found it in Seeley Lake, Colo.; Willey, 1923, in Quill Lakes, Saskatchewan; and it was present in collections made by Young in Devils Lake, N. Dak. Schacht,

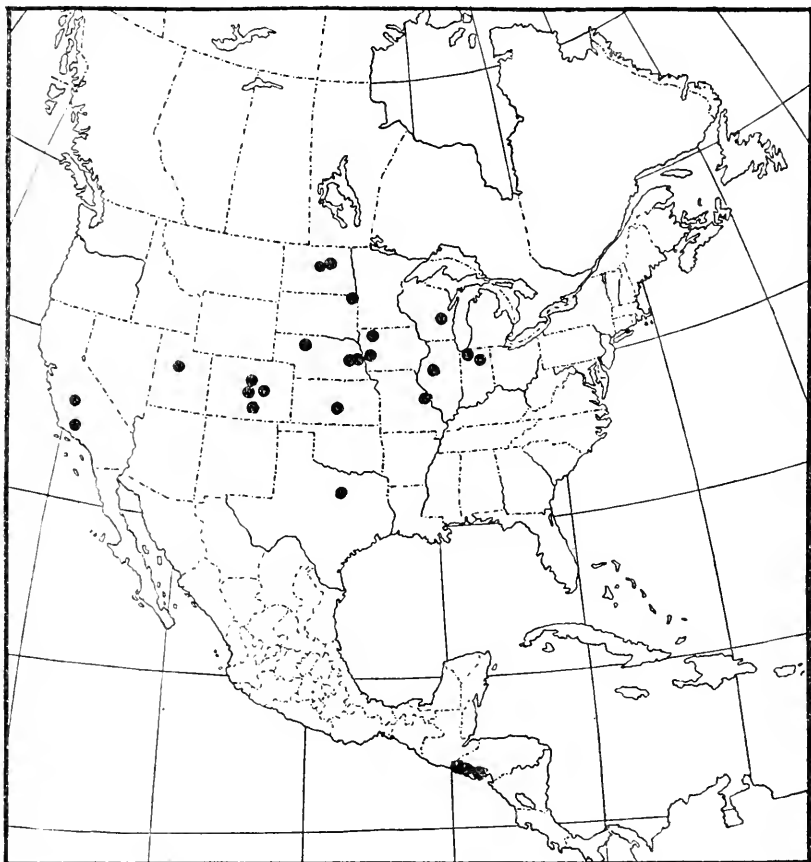


FIGURE 10.—DISTRIBUTION OF *DIAPTOMUS SICILOIDES* LILLJEBORG

1897, reported it from Cedar Lake and Fox Lake, Ill. Its most western location is Yellowstone Park, where Forbes collected it. Its distribution is shown in Figure 9.

**DIAPTOMUS SICILOIDES** Lilljeborg, 1889

The type specimens of *D. siciloides* were collected in Lake Tulare, Calif. Schacht, 1897, found it abundant in the Illinois River near Havana. Brewer, 1898, found it at Lincoln, Nebr.; and Pearse, 1905,

found it not only at Lincoln but at Omaha and in Cherry County, and in Council Bluffs, Iowa. Schacht, 1897, and later, Stromsten, 1920, reported it from the Okoboji Lakes in Iowa. Dodds, 1908, 1915*a*, 1917, 1920, 1924, found it in Palmer Lake and La Junta, Colo. The writer has found it in Colorado at Hugo and in lakes about

Pikes Peak; in Gunnison Reservoir, Utah; at Los Angeles, Calif.; in Devils Lake, N. Dak., in collections made by Young; in Big Stone Lake between South Dakota and Minnesota; in Cedar Lake, Wis.; in a collection made by Shelford at Medora, Kans., in Turkey Lake and at Hammond, in Indiana; in Crève Coeur Lake and other localities near St. Louis, Mo.; and in a collection made by Birge at Hutchins, Tex. Juday, 1915, collected it at Coatepeque and Lake Hopango, San Salvador, and it was found in a collection made by Hildebrand in Lake Chamico, in San Salvador. It has not been found north of the United States. Figure 10 shows its distribution.

**DIAPTOMUS SIGNICAUDA** Lilljeborg, 1889

In the description of this species it was said to have been collected in the Sierras, Calif. It was found in collections made by C. F. Baker in Marlette Lake, Nev., and in collections made by H. B. Ward in several small lakes near Lake Tahoe. It was contained in material gathered by Juday in Hocketts Lakes, Calif., and Boulder, Colo. Stromsten, 1917, noted its occurrence in the Okoboji Lakes

in Iowa, and the writer found it in Wheat Meadows and Duck Lake in Calaveras County, Calif. Its distribution is shown in Figure 12.

**DIAPTOMUS SPATULOCRENATUS** Pearse, 1906

Pearse found *D. spatulocrenatus* on Nantucket Island. The writer found it in a collection made by A. A. Doolittle from Lake Sebago, in Maine. In a comparison of the Lake Sebago material with the original description certain minor differences were noted. The presence of lateral spines on the first abdominal segment of the female was not mentioned by Pearse. The second basal segment of

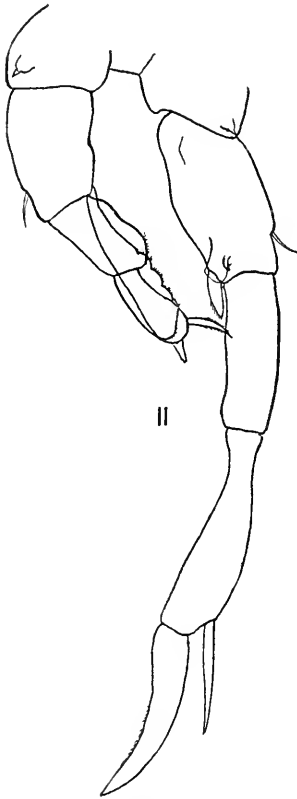


FIGURE 11.—*DIAPTOMUS SPATULOCRENATUS* PEARSE, FIFTH LEFT FOOT OF MALE,  $\times 424$

the right fifth foot of the male has, as shown in Figure 11, in addition to the small tubercle mentioned by Pearse, a hyaline appendage near the inner distal angle and at the base of this appendage a small recurved hook. The left endopodite of the male fifth foot was one-segmented instead of two-segmented as in the Nantucket specimens.

**DIAPTOMUS STAGNALIS Forbes, 1882**

*Diaptomus stagnalis* was described by Forbes in 1882. His description was not complete but was sufficient to clearly identify the species. Herrick, in 1882, proposed a provisional name of *giganteus* for a form for which he gave no description, but his figures show that it is identical with Forbes's *stagnalis*; in 1884 he acknowledged that

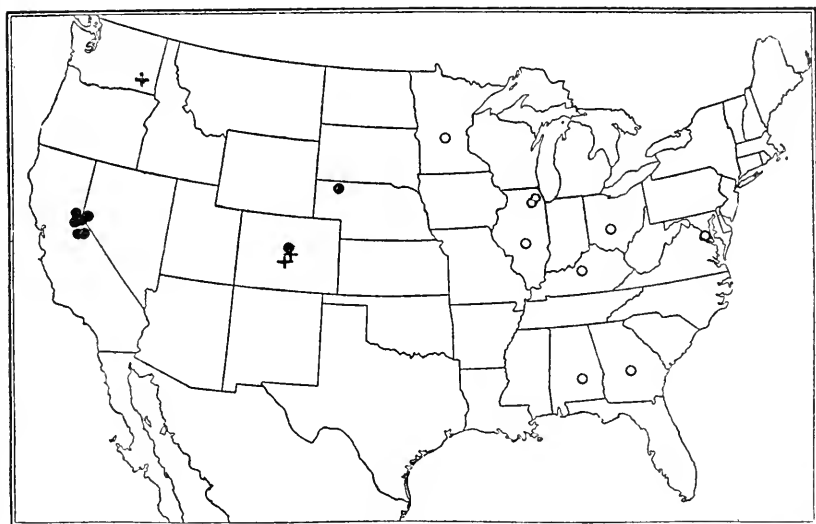
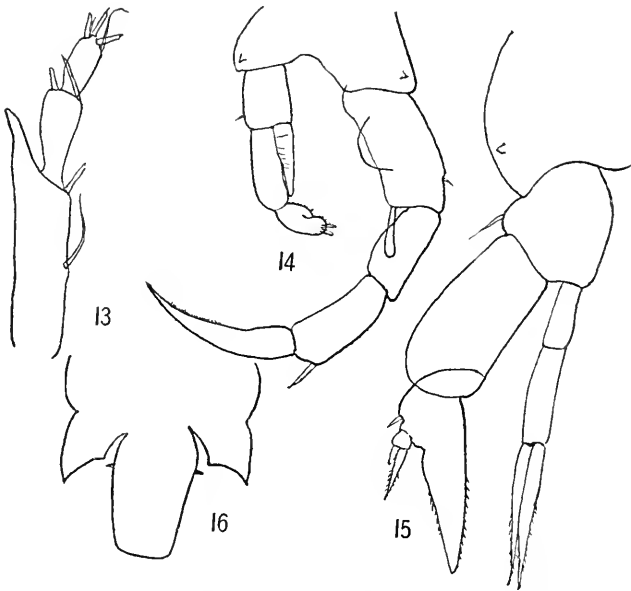


FIGURE 12.—DISTRIBUTION OF *DIAPTOMUS STAGNALIS* FORBES (○), *D. SIGNICAUDA* LILLJEBORG (●), AND *D. WASHINGTONENSIS* MARSH (+)

Forbes's name had the right of priority and gave a somewhat careful description with figures of the wing of the last cephalothoracic segment and of the fifth foot of the male. In 1895 Herrick and Turner again described the species with a number of figures. The most complete description is that by Schacht in 1897, but he gave but one figure, the terminal segments of the right antenna of the male. Marsh in 1907 reproduced the description of Schacht, using figures from Forbes, and Herrick and Turner. More recently the species has been found in Virginia, near Washington, and from this material figures are given of the terminal segments of the right antenna of the male, Figure 13; the fifth feet of both sexes, Figures 14 and 15;

and the "wings" of the last cephalothoracic segment. Figure 16. The material has shown certain minor differences from Schacht's description. The lateral spines of the first segment of the female abdomen are not "large" but of moderate size. The furcal rami are ciliate on outer as well as inner margins.

There is considerable variation in the form of the endopodite of the left fifth foot of the male. In the figure of Herrick, in 1882, cross striae or partitions are shown. In 1884 Herrick says that the "inner ramus is marked with oblique ridges," and these are shown in his figure. Herrick and Turner, in 1895, say that "it is corrugate inter-



FIGURES 13-16.—13, *DIAPTOMUS STAGNALIS* FORBES, TERMINAL SEGMENTS OF RIGHT ANTENNA OF MALE;  $\times 307$ . 14, *DIAPTOMUS STAGNALIS* FORBES, FIFTH FOOT OF MALE;  $\times 109$ . 15, *DIAPTOMUS STAGNALIS* FORBES, FIFTH FOOT OF FEMALE;  $\times 307$ . 16, *DIAPTOMUS STAGNALIS* FORBES, SHOWING WINGS OF LAST CEPHALOTHORACIC SEGMENT OF FEMALE;  $\times 55$

nally." and their figures show corrugations on the *outer* margin. Schacht, in 1897, says "inner margin rugose." In the specimens examined by the author these markings which are striations rather than corrugations vary in their distinctness and in number. Sometimes there are not more than three or four; at others there may be six or more. In some cases they cross the endopodite at right angles, while in others they are oblique. In none of the individuals examined were they distinct enough to warrant the use of the words "rugose" or "corrugations." The appendages of the terminal segment of the left exopodite consist of an outer



digitate process and an inner spine which is nearly straight. In many of the females there are only two ova.

Forbes found it in central Illinois. Herrick and Turner, 1895, reported it in Minnesota, Ohio, Kentucky, and in 1887 Alabama. Turner, 1910, found it in Georgia. The author has found it in Jackson Park, Chicago, and in collections made by H. E. Barber in a temporary pool near Great Falls, Va. It is an early spring form. Its distribution is shown Figure 12.

**DIAPTOMUS TENUICAUDATUS Marsh, 1907**

*D. tenuicaudatus* was described from material collected by Dr. Russell T. Congdon in Glen Lake, Saskatchewan. It was found in collections made by Prof. H. H. Mackay in Lake Nipigon, north of Lake Superior, and recently the author has collected it from Utah Lake, Utah. Its distribution is shown in Figure 6.

**DIAPTOMUS TRYBOMI Lilljeborg, 1889**

*D. trybomi* has not been reported by any one since the original description in DeGuerne and Richard's monograph. It was said to have been collected by M. Trybom at "Multrooma Falls, Oregon." It is to be presumed Multnomah Falls is the locality.

**DIAPTOMUS TYRELLI Poppe, 1888**

*D. tyrelli* was described from collections made in Summit Lake, British Columbia. It was described in manuscript under the name *D. fresnanus* by Lilljeborg from material obtained near Fresno, Calif. From collections made in the Pribilof Islands, Alaska, Juday and Muttkowski in 1915 described it calling it *D. pribilofensis*. It was found in collections made by the United States Bureau of Fisheries in Alturas Lake, Idaho. It has also been found in Yellowstone National Park and in localities in southeastern Utah. Its distribution is shown in Figure 5.

**DIAPTOMUS VIRGINIENSIS Marsh, 1915**

*D. virginiensis* has thus far been found in only one locality, in Black Pond near Great Falls, Va.

**DIAPTOMUS WARDI Pearse, 1905**

*D. wardi* was described from material collected near Spokane, Wash. Juday and Muttkowski 1915 reported from St. Paul Island, near Alaska, and the author has found it in collections from the same locality.

## DIAPTOMUS WASHINGTONENSIS Marsh, 1907

*D. washingtonensis* was first found in collections made by Prof. B. H. Brown at Walla Walla, Wash. Later it was found in collections made by Dr. H. L. Shantz in Portland Reservoir and Palmer Reservoir at Colorado Springs, Colo. Its distribution is shown in Figure 12.

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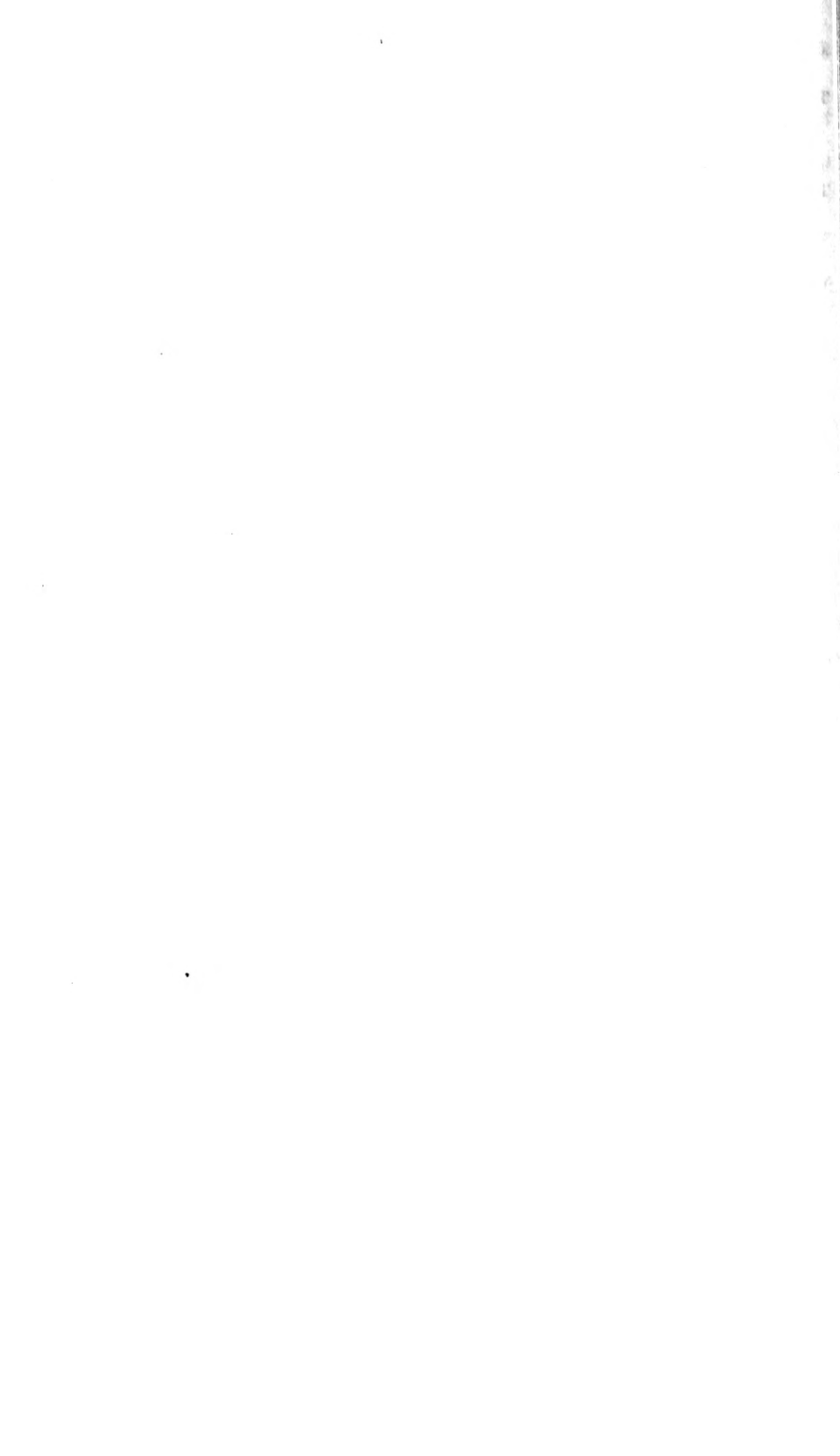
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# A NEW CRAB FROM THE EOCENE OF FLORIDA

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The material here described was collected in part by the United States Geological Survey many years ago, and in greater numbers more recently by the Florida State Geological Survey, which has presented to the United States National Museum the specimen designated as holotype.

## Family XANTHIDAE

### OCALINA, new genus

*Genotype*.—*Ocalina floridana*, new species.

Carapace broadly suboval, margin lobulate, surface rough. Front broad, consisting of 4 lobes which are distinct from the tooth at the inner angle of the orbit. Orbit in an almost vertical plane, subcircular, closed, the inner margin of the inner lower angle being closely applied to the lower side of the inner upper angle. Basal article of antenna remote from orbit terminating not directly below the orbital tooth but below the sinus separating that tooth from the front proper. Third and fourth segments of male abdomen fused. Chelae resembling those of *Cancer*; longitudinal rows of tubercles on palm; fingers elongate.

This genus is nearest to the Recent genus *Carpilius* Leach<sup>1</sup> of which one species, *Carpilius corallinus*,<sup>2</sup> a crab of large size, is not uncommon in the West Indies and the Bahamas. It differs from *Ocalina* in its narrower front without a median emargination, in the absence of a distinct inner orbital tooth, in the inner orbital gap, which though narrow is always well defined and occupied by the antenna, in the smooth carapace and margins, and in the shorter chelae with swollen palms and short, stout fingers. In *Palaeocarpilius* A. Milne Edwards<sup>3</sup> (Eocene) the basal article of the antenna is long and reaches to the orbit, the carapace is smooth, nontuberculate, except on the lateral margins, and the fingers are short.

<sup>1</sup> In Desmarest, *Diet. Sci. Nat.*, vol. 28, 1823, p. 228.

<sup>2</sup> Herbst, *Natur. Krabben u. Krebse*, vol. 1, 1783, p. 133, pl. 5, fig. 10.

<sup>3</sup> *Ann. Sci. Nat., Zool.*, ser. 4, vol. 18, 1862, p. 51.

*Caloranthus* A. Milne Edwards,<sup>4</sup> a Cretaceous genus in France, type *C. formosus* A. Milne Edwards,<sup>5</sup> has a form and rough surface similar to those of *Ocalina*, but the front is straight and undivided, the circular orbit has a small inner gap, the basal article of the antenna reaches the front, the chelipeds are as rough as the carapace.

OCALINA FLORIDANA, new species

Plates 1-3

*Description of holotype.*—Carapace broadly suboval, very convex, more so longitudinally than transversely, antero-lateral margin a little longer than postero-lateral margin. Front more than one-third width of carapace, orbit subcircular. Antero-lateral margin with ten thick, similar, closely placed lobules, including that at outer end of orbit. Dorsal surface rough except in the middle or mesogastric region with low conical tubercles which are largest about the anterior and antero-lateral regions, smallest and more or less coalescent across the posterior third of the carapace, highest and most acute near the lateral angle (see also paratype *c*). Surface punctate, especially between tubercles, punctae visible to the naked eye. Orbit circular, closed, ornamented above with ten or eleven tubercles, all small, except those at inner and outer angles; below four low tubercles. Basal article of antenna obliquely-transversely placed, its extremity at a considerable distance from the orbit (paratype *b*). The broad front is most prominent near the middle and has a deep median V-shaped emargination; each half is subdivided into two lobes: the inner lobe is triangular, its edge shallow-trilobulate or tuberculate; the outer lobe is transverse and bilobulate; in the sinus between the lobes there is a lobule.

Paratype *a* shows part of the ventral surface of the body and appendages of a male. The sternum, abdomen, and lower surface of carapace are smooth and punctate. The outer maxilliped resembles that of *Carpilius*. The left one is preserved but is detached and turned at a right angle to its normal position; the merus is also bent at an acute angle with the ischium. The ischium is longer than broad, the merus is broader than long and widens inwardly, inner margin angled; exognath broad and long, reaching end of merus of endognath. Merus of ambulatory legs broad, compressed. The fourth, fifth, and sixth segments of the male abdomen are each broader than long; the fifth twice as broad as long, the sixth longer, the fourth still longer; the cavity formerly occupied by the terminal segment shows it to have been triangular and more than half as long as broad.

<sup>4</sup>Ann. Sci. Nat., Zool., Ser. 4, vol. 20, 1863, p. 282; ser. 5, vol. 1, 1864, p. 43.

<sup>5</sup>Idem, vol. 20, 1863, p. 326, pl. 9, figs. 1-1d; ser. 5, vol. 1, 1864, p. 41.



*Paratype d.*—Chelipeds stout, similar, unequal. Merus nearly as wide as its greatest length, smooth, largely mottled with short transverse color marks. Carpus covered with low squamose tubercles. Propodus increasing in height from proximal to distal end; lower margin nearly straight, slightly sinuous; upper margin arcuate; outer surface very convex transversely, inner surface less so. Outer surface, except in the lower part, rough with tubercles arranged largely in longitudinal rows, and with their acute tips pointing distad. A short deep transverse furrow outside, opposite the articulation of the dactylus. Fingers stout, compressed, meeting when closed, tips acute; prehensile edges subacute and furnished with a few low tubercles. Propodal finger bluntly carinate, with two longitudinal rows of tubercles and punctae outside; dactylus (paratype *c*) with four rows of tubercles on the upper half, two close together above, one on inner surface, the other on outer surface.

*Measurements.*—Holotype (sex unknown), total length of carapace 74, width of same 108, fronto-orbital width 52, width of orbit 5.7, width between orbits 40.6, width of front exclusive of orbital tooth 32.5 mm. Paratype *d*, length of major propodus about 72, greatest height of same 35, length of dactylus above 39.3, below 28.5 mm.

*Occurrence.*—Florida: Eocene series:

Clark, Alachua County; nummulitic limestone 50 feet below the surface: "Vicksburgian": 1896; L. M. Everett, United States Geological Survey; one carapace, dorsal view; paratype *c*; Cat. No. 137871, United States National Museum.

Hales Siding, 5 miles east of Newberry, Alachua County; in quarry of Ocala Road Material Corporation; depth, 35 feet from top of Ocala limestone; Thomas Sexton, collector; donated to Florida State Geological Survey by A. T. Thomas; one pair of chelipeds; paratype *d*.

About 2 miles north of Williston, Levy County; in quarry of Thompson Williston Co.; 30 feet from surface; Ocala limestone; July 6, 1928; G. M. Ponton, Florida State Geological Survey; one specimen very incomplete, lacking the dorsal surface of the carapace; paratype *i*.

One mile south of Williston, Levy County; in quarry of Ocala-Tampa Lime Rock Co.; Ocala limestone, 30 feet below surface; October 3, 1928; H. Gunter and G. M. Ponton, Florida State Geological Survey; parts of three specimens; paratypes *f*, *g*, and *h*.

Ocala, Marion County; 1891; J. Kort, United States Geological Survey; one chela, incomplete, showing part of palm and dactylus; paratype *e*; Cat. No. 370957, United States National Museum.

Southwest City Limits, Ocala, Marion County; in pit of Florida Lime Co.; procured from S. Phillips, January, 1917; submitted by Florida State Geological Survey, through Dr. E. H. Sellards; one

specimen is a rock containing a carapace (holotype, Cat. No. 370956, United States National Museum) and another individual showing the ventral surface of body and appendages (paratype *a*); a second specimen (paratype *b*) shows part of the ventral surface.

#### EXPLANATION OF PLATES

##### *Ocalina floridana*

#### PLATE 1

- FIGURE 1. Dorsal view of carapace, paratype *c*,  $\times \frac{1}{5}$ .  
 2. Front view of carapace of holotype,  $\times \frac{1}{5}$ .  
 3. Dorsal view of carapace of holotype,  $\times \frac{1}{5}$ .

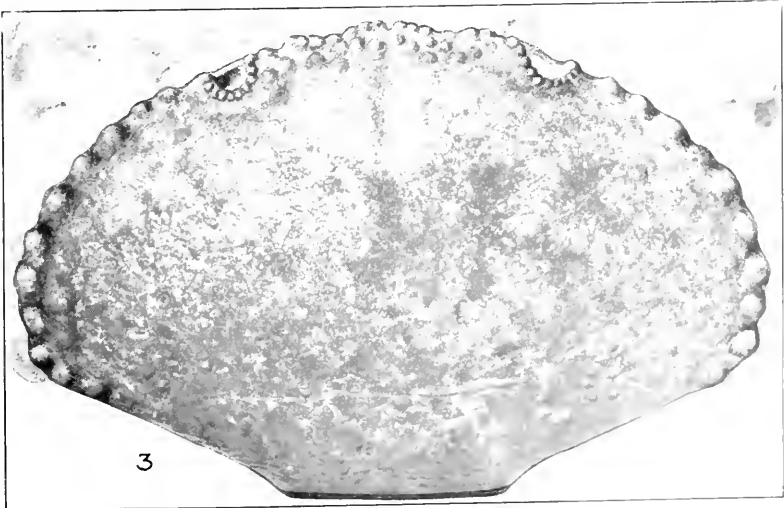
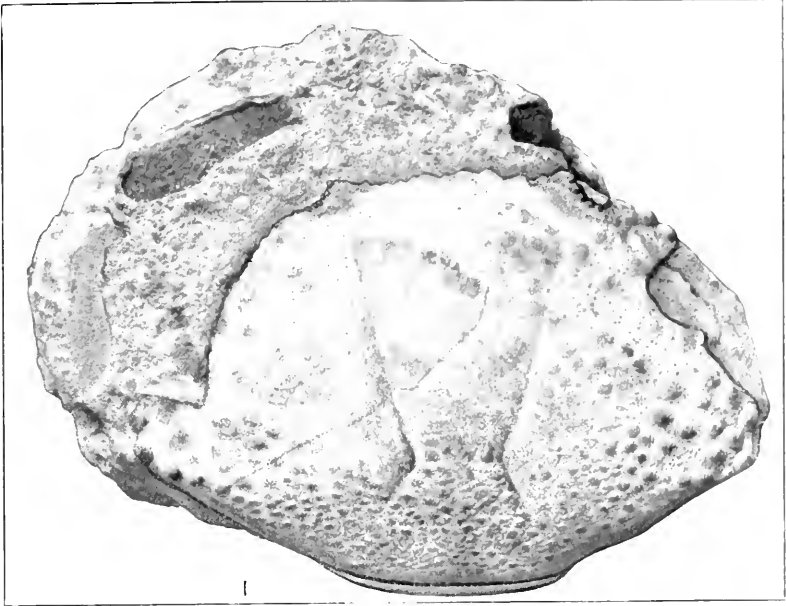
#### PLATE 2

- FIGURE 1. Ventral view of paratype *b*,  $\times \frac{1}{5}$ . *a*. Basal article of antenna. *o*.  
 Imer lower angle of orbit.  
 2. Chelipeds of paratype *d*, showing outer view of chelae,  $\times \frac{2}{3}$ .

#### PLATE 3

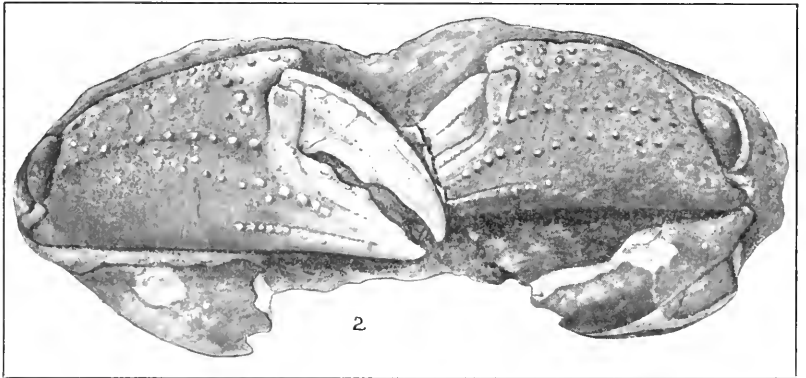
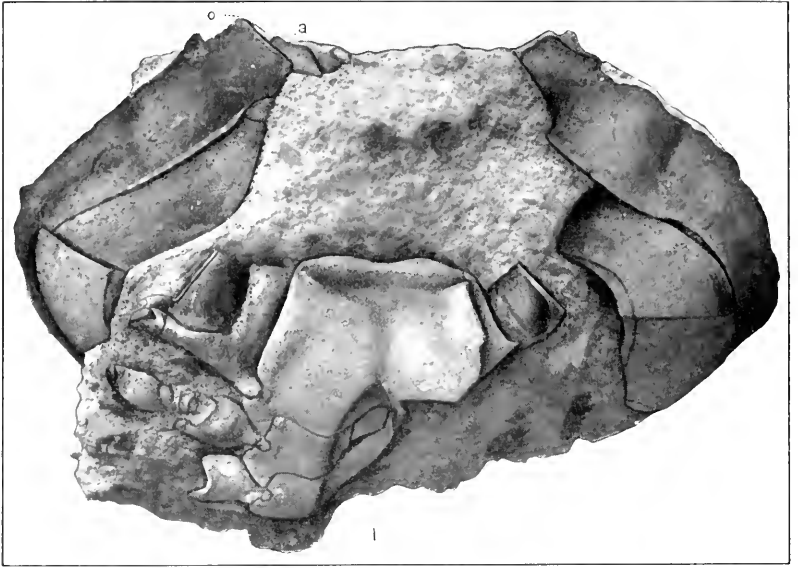
- FIGURE 1. Ventral view of paratype *a*, and merus of a larger specimen,  $\times \frac{2}{15}$ .  
 2. Incomplete chela, paratype *c*, upper view,  $\times \frac{2}{15}$ .  
 3. Same, outer view,  $\times \frac{2}{15}$ .





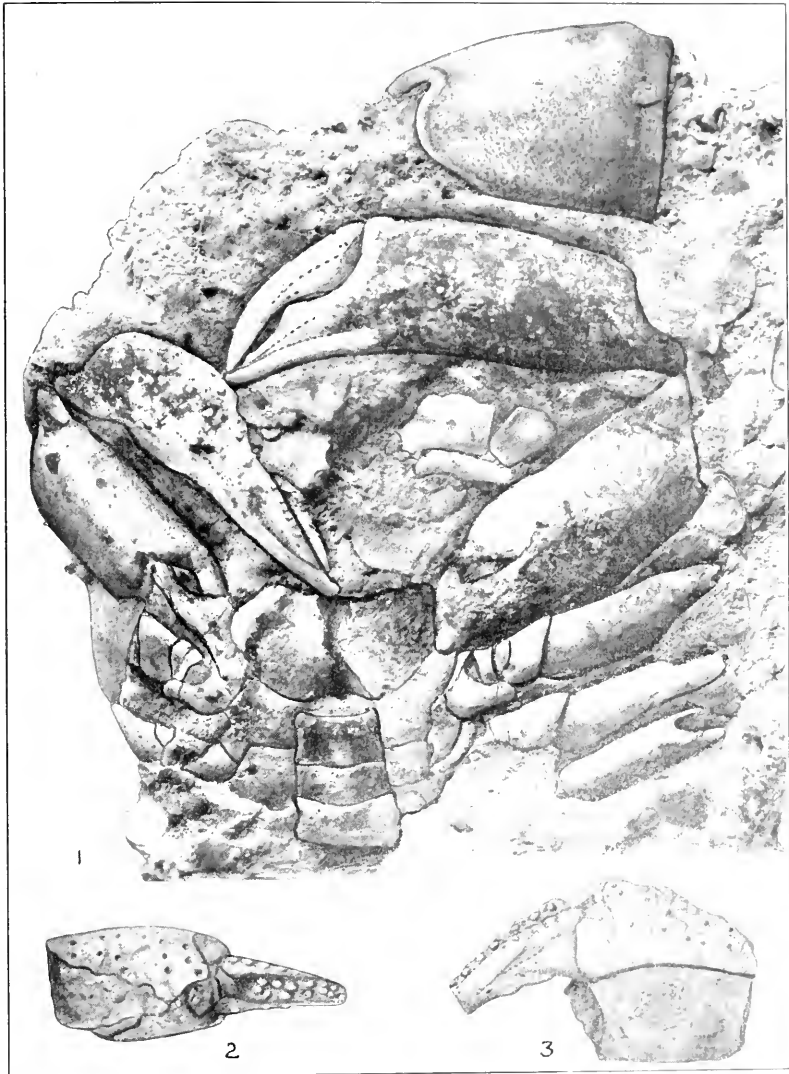
*Ocalina floridana*, Eocene crab

FOR EXPLANATION OF PLATE SEE PAGE 4



*Ocalina floridana*, Eocene crab

FOR EXPLANATION OF PLATE SEE PAGE 4



OCALINA FLORIDANA, EOCENE CRAB

FOR EXPLANATION OF PLATE SEE PAGE 4



A NEWLY FOUND METEORIC STONE REPORTED BY  
W. B. LANG FROM PECK'S SPRING, MIDLAND COUNTY,  
TEX.

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By GEORGE P. MERRILL

*Head Curator of Geology, United States National Museum*

(With chemical analysis by F. A. GOXYER)

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The stone here described was received at the United States National Museum from Mr. W. B. Lang of the United States Geological Survey to whose kindly efforts we are indebted both for the accession<sup>1</sup> and the information regarding its occurrence and finding, as quoted below:

The stone was found by Mr. R. De Chicchis about one-half mile east of the Judkins ranch house on section 14, township 3, block 57, Texas & Pacific Railroad survey, Midland County, Tex., on May 15, 1926. As found it was about the size and shape of a good-sized potato, was well encrusted, and showed little evidence of having been marred by contact from fall, hammering, or chipping. The portion received at the Museum weighed almost exactly 800 grams and represented slightly less than one-half of the original, the remainder having been broken away and scattered among numerous individuals. There was nothing to indicate the exact point of fall though the fact that the stone showed no signs of wear or abrasion leads to the conclusion that it was near by, if not on the exact spot. There is no record of its having been seen to fall.

Broken and polished surfaces of the stone show an unusually dense, dark-gray, nearly black ground, thickly studded with firmly embedded gray chondritic forms of all sizes up to 5 or 6 millimeters. Minute points of metal and metallic sulphide are thickly and irregularly distributed through the mass; in a few instances the first mentioned is clustered collarlike about a chondrule in such a manner as to give countenance to the theory once advanced by Nordenskjöld to the effect that it was derived from the silicate through a process of reduction.<sup>2</sup>

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<sup>1</sup> Cat. No. 831, U. S. N. M.

<sup>2</sup> Geol. Föreningen Stockholm Förhandlingar, 1878-79, p. 60.

In the thin section the stone shows a pronounced cataclastic structure composed of fragmental and imperfect chondrules interspersed with fine granular particles of silicate minerals and the usual metallic and sulphide particles. The chondrules vary from the densely radiating enstatite type to porphyritic irregular and fragmental forms in which the phenocrysts are mainly enstatite; olivine is abundant often in the form of irregular chondrules with the common grate, or barred structure. (See pl. I.) No feldspars or other silicate constituents were noted. There are, however, abundant small, colorless, and irregular isotropic areas that might on casual inspection be mistaken for a residual glass but for the pronounced fragmental character of the stone. It is to be further noted that these areas are not interstitial but occur for the most part if not wholly in the body of the individual enstatites and olivines. The metal, it may be stated, occurs in particles of unusual minuteness, few of them reaching a millimeter in diameter while many are microscopic and so small that even when reduced to a fine powder by rubbing in an agate mortar the silicates were found to still contain minute particles.

A pronounced finely granular structure is prevalent throughout, suggestive of crushing and frequent and abrupt changes in temperature. The stone is, however, unusually hard and dense.

Mr. Gonyer's analysis yielded results as below:

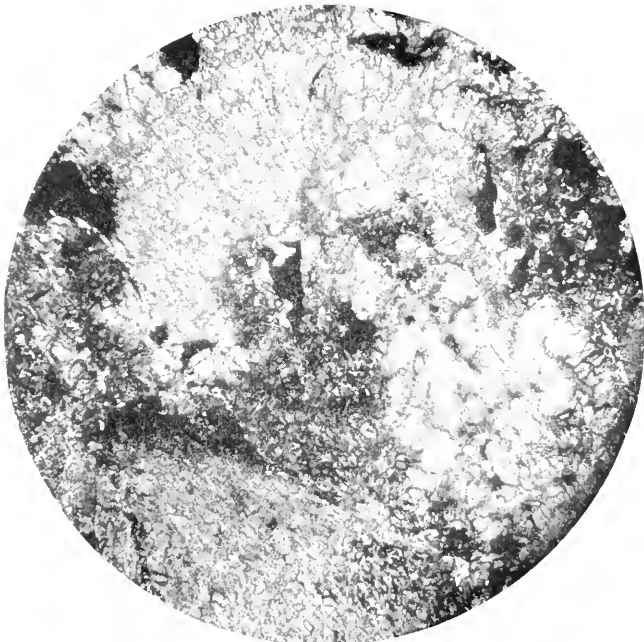
A total of 11.2652 grams was digested in ammonium mercuric chloride. This yielded 10.6458 grams, or 94.51 per cent of silicates, and 0.6194 gram, or 5.4 per cent, of metal. These yielded as below:

|                                      | Per cent |                     |
|--------------------------------------|----------|---------------------|
| SiO <sub>2</sub> .....               | 37.57    | } Silicate portion. |
| Al <sub>2</sub> O <sub>3</sub> ..... | 7.12     |                     |
| Cr <sub>2</sub> O <sub>3</sub> ..... | .35      |                     |
| FeO.....                             | 20.80    |                     |
| CaO.....                             | 2.14     |                     |
| MgO.....                             | 22.71    |                     |
| K <sub>2</sub> O.....                | .21      |                     |
| Na <sub>2</sub> O.....               | .78      |                     |
| NiO.....                             | .55      |                     |
| P <sub>2</sub> O <sub>5</sub> .....  | .24      |                     |
| FeS.....                             | 2.27     | } Sulphide portion. |
| Fe.....                              | 5.03     |                     |
| Ni.....                              | .42      | } Metallic portion. |
| Co.....                              | .01      |                     |
| Cu.....                              | .002     |                     |

100.202

The analysis brings out no new or striking feature, though a little lower in metal than one would assume from an examination of a polished surface, and considerably below that of the average (12.45 per cent) that I have elsewhere given. On the other hand, it is high in alumina. There is, however, no reason to question the reliability of the analysis.





PHOTOMICROGRAPHS OF PECK'S SPRING METEORITE

FOR EXPLANATION OF PLATE SEE PAGE 2



A NEW NEMATODE, *SINCOSTA* ABERRANS, NEW GENUS,  
AND NEW SPECIES FROM A RODENT

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By GLENWOOD C. ROE

*Of the Zoological Division, Bureau of Animal Industry, United States Department of Agriculture.*

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The specimens described here are from a collection made by Dr. H. W. Graybill at Monmouth Junction, N. J., from the small intestine of a "wild mouse."<sup>1</sup> This nematode belongs to the family Trichostrongylidae Leiper, 1912, and the subfamily Heligmosominae Travassos, 1914. This species appears to belong to a new genus, for which the name *Sincosta* is proposed.

I wish to thank Dr. M. C. Hall, chief of the zoological division, and Dr. E. W. Price, of the same division, for suggestions in connection with the study of this worm.

*SINCOSTA*, new genus

*Generic diagnosis.*—Heligmosominae: Worms delicate and whitish in color when preserved. Cephalic cuticle inflated, usually asymmetrically (fig. 1). Male bursa well developed, definitely asymmetrical and indistinctly trilobed. The bursal rays (fig. 2) are asymmetrical to some extent and in the type and only known species are as follows: The ventro-ventral and the latero-ventral rays on both sides of the bursa are united in about their proximal third, with the latero-ventral ray on the right side considerably thicker and somewhat longer than the other rays. The externo-lateral, medio-lateral, and postero-lateral rays on both sides of the bursa are united in at least their proximal third, are divergent distally and are of about equal size. Each externo-dorsal arises from a thickened heavy base, and usually one base exhibits a knob on its median aspect and the other base a corresponding depression opposite it. Dorsal ray absent. This lack of a dorsal ray is the most striking of the generic

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<sup>1</sup> The original source of the material was designated by Mr. H. W. Graybill in 1923 as a "wild mouse" and no further information could be obtained from him as to the identity of the host.

characters. Spicules (fig. 3) bifurcated for most of their length. Female with vulva near anus; ovejector and sphincter well developed. The eggs are oval and embryonated within the uterus in the one species in the genus represented in our material.

*Type species.*—*Sincosta aberrans*, new species.

SINCOSTA ABERRANS, new species

*Specific diagnosis.*—*Sincosta*: Cuticle (fig. 1) of cephalic region coarsely striated transversely. The head measures about  $34\mu$  in diameter. Four submedian papillae and 2 lateral amphids present. The esophagus is about  $480\mu$  long by  $42\mu$  in diameter near its posterior extremity. Nerve ring not observed.

*Male* loosely coiled several times, 4 to 7.8 mm. long with a maximum diameter of 110 to  $140\mu$  immediately in front of the bursa. The bursa (fig. 2) is large and composed of two unequal lateral lobes, the right being the larger, with an indistinct dorsal lobe present. The rays of the bursa, in most cases, terminate near the edge of the bursa. The ventro-ventral and the latero-ventral rays on the left side are thick, short, and united in their proximal half, while the equivalent rays on the right side are as thick, but are much longer and are united in their proximal third. The externo-lateral, medio-lateral, and the postero-lateral rays on the right side are united in their proximal third, and those on the left side in their proximal half; on both sides they are divergent and of about equal thickness distally. Each externo-dorsal (fig. 2) arises from an enlarged base, of which the left base usually exhibits, on its median aspect, a slight depression corresponding to and opposite a knob on the right base. The externo-dorsals may be unequal in length; these rays are more slender than the other rays, and may or may not be branched, the absence of the branches being the usual condition. However, as observed in one specimen, branching occurred about  $50\mu$  from the distal end of the left externo-dorsal, the size of the branch being approximately the same as the terminal portion of the ray. Dorsal ray absent. Spicules (fig. 3)  $475$  to  $500\mu$  long, and bifurcated posteriorly along most of their length, the bifurcation occurring from  $30$  to  $76\mu$  from the proximal end.

It is assumed here that the peculiar situation as regards the dorsal-ray system is due to the suppression of the dorsal ray and the persistence of the externo-dorsals. An alternative interpretation is that two dorsal rays are present and the externo-dorsals are suppressed. We accept the first alternative temporarily.

*Female* 15 to 19.2 mm. long by  $100\mu$  to  $200\mu$  in diameter in the immediate prevulvar region and tightly coiled in an elongated spiral (fig. 4). The vulva (fig. 5) is a transverse slit located 350 to  $450\mu$  from the end of the tail and is supplied with a series of convergent

muscles; immediately posterior to it is a prominent cuticular ridge. A small cuticular spine is located on the tip of the tail, forming a mucronate tip. The anus is located about  $90\mu$  from the tip of the tail. The muscular ovejector, including the sphincter, is 350 to  $450\mu$  long. The eggs are oval, thin shelled, 56 to  $66\mu$  long by about  $35\mu$  wide, and embryonated within the uterus in our material.

*Host*.—"Wild mouse."

*Location*.—Small intestine.

*Locality*.—New Jersey (Monmouth Junction), United States.

*Type specimen*.—Cat. No. 25475, U. S. National Museum Helminthological Collection.

The outstanding characters in this genus and species in comparison with other forms in the subfamily Heligmosominae or with strongyles in general, is the absence of the dorsal ray. The branching of an externo-dorsal, found in one specimen, and the enlarged base of each externo-dorsal with the accompanying knob and depressions found in all specimens, may or may not be vestigial remnants of the dorsal ray. The alternative possibility, already noted, that the rays present are dorsal rays, would suggest that the branching was a remnant of a suppressed externo-dorsal ray. Subsequent developments in helminthology may afford definite evidence in support of one of these alternatives.

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1916.—Nematode parasites of mammals of the orders Rodentia, Lagomorpha, and Hyracoidea. Proc. U. S. Nat. Mus., vol. 50, pp. 1-258, pl. 1, fig. 290.

YORKE, WARRINGTON; and MAPLESTONE, P. A.

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#### EXPLANATION OF PLATE

*Sincosta aberrans*, new species

*an.*, anus; *e. d.*, externo-dorsal ray; *e. l.*, externo-lateral ray; *int.*, intestine; *l. v.*, latero-ventral ray; *m. l.*, medio-lateral ray; *ovej.* 1, 2, 3, ovejectors; *p. l.*, postero-lateral ray; *sp.*, spicules; *ut.*, uterus; *vul.*, vulva; *v. v.*, ventro-ventral ray.

FIG. 1. Anterior end of male.

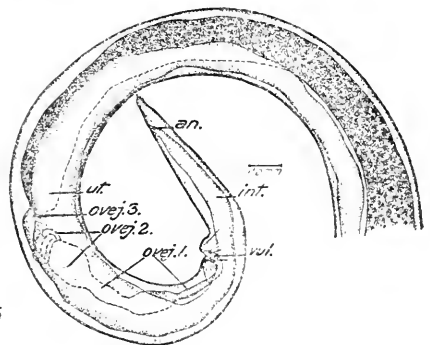
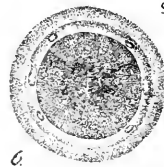
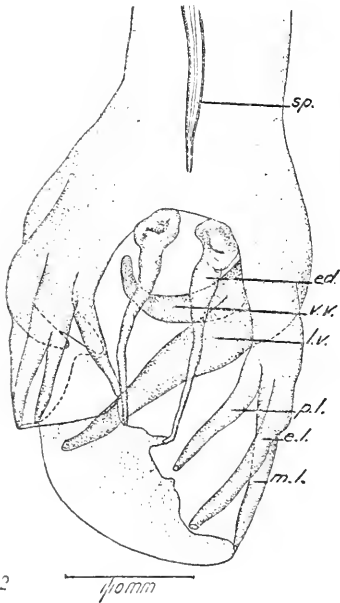
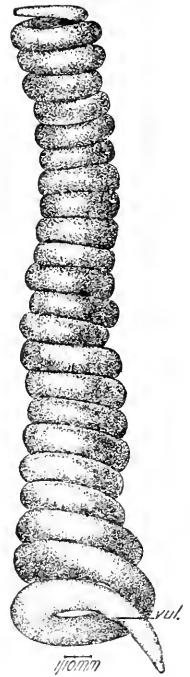
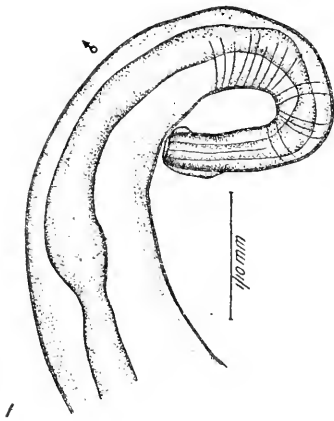
2. Dorsal view of bursa.

3. Spicules.

4. Female showing characteristic tight spiral coil.

5. Posterior end of female showing genital organs.

6. Head, ea face view. Enlarged.



SINCOSTA ABERRANS, NEW SPECIES

FOR EXPLANATION OF PLATE SEE PAGE 3

# A SYNOPSIS OF THE TREMATODE FAMILY SCHISTOSOMIDAE, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES

By EMMETT W. PRICE

*Of the Zoological Division, Bureau of Animal Industry, United States Department of Agriculture*

The family Schistosomidae is composed of a number of genera of diecious trematodes parasitic in the blood-vascular system of warm-blooded vertebrates. The manner in which the free-swimming larval forms gain access to the body (skin penetration by the cercaria) is correlated with the fact that many of the species are parasitic in aquatic birds, as these birds are naturally exposed to attack in cercaria-infested waters. Several species are of considerable medical and veterinary importance; three species are parasites of man, and several species occur in ruminants and other domesticated animals. The forms found in man may produce severe lesions in the liver, bladder, and intestine, frequently resulting in death; those occurring in the domesticated animals produce similar lesions, but as these forms have not received as much study as the human species, less is known of their medical and economic importance.

Little is known of the distribution of schistosomes in the United States. Tanabe (1923) described a new genus for a new species which he succeeded in rearing in white mice following exposure to infection with cercariae obtained from *Lymnaea palustris* in Boston, Mass.; Chapin (1924) reported a blood fluke from *Marila affinis*; and more recently Linton (1928) described an *Ornithobilharzia* species from water birds at Woods Hole, Mass. Several cercariae of the schistosome type have been described from snails in this country and it appears probable that these trematodes are not uncommon but have been overlooked because of their peculiar location in the body.

In this paper three new genera and species are described from North American hosts, and *Bilharziella polonica* is reported from this continent, apparently for the first time. As a result of the study of these forms, it became apparent that a synopsis of this group would be useful, as the descriptions of many species have been given in

publications having a more or less limited circulation. The writer has, therefore, attempted to assemble descriptions of all the genera and species, and has prepared keys which will aid in the identification of these trematodes. Unfortunately many of the descriptions are inadequate as they have been based in many instances on the study of a limited number of specimens. Unless stated to the contrary the descriptions of known species have been compiled from original sources.

A few changes have been made in the classification of this group, which appear necessary for proper coordination. A new subfamily, Bilharziellinae, is proposed for those species resembling *Bilharziella polonica* in form or organization. The genus *Macrobilharzia* Travassos is regarded as a synonym of *Ornithobilharzia* Odhner, the type species, *M. macrobilharzia*, apparently being congeneric with *Ornithobilharzia intermedia* Odhner. *Schistosoma bomfordi* Montgomery and *S. turkestanicum* Skrjabin have been transferred to the genus *Ornithobilharzia*, as neither of these species are congeneric with *Schistosoma haematobium* (Billharz) type of *Schistosoma*, and both of them have characters of the genus *Ornithobilharzia*.

The writer desires at this time to acknowledge his indebtedness to the following for kindly placing specimens of schistosomes at his disposal for study and comparison: Dr. C. W. Stiles, United States Public Health Service; Dr. J. H. Sandground, Harvard University; Prof. Edwin Linton, University of Pennsylvania; Dr. Henry B. Ward, University of Illinois; Capt. J. H. St. John, Army Medical School; and Lieut. Commander John Harper, Naval Medical School. He also desires to express his appreciation to Dr. M. C. Hall, chief of the zoological division, Bureau of Animal Industry, for suggestions in the preparation of this paper; to Dr. A. Hassall of the zoological division for suggestions and material assistance in obtaining the literature; to Dr. Robert Formad of the pathological division, for making translations of papers published in the Russian language; to Dr. Paul Bartsch, of the United States National Museum, for supplying correct names for the snail hosts; and to Dr. C. W. Richmond, of the United States National Museum, for supplying correct names for the birds from which schistosomes have been reported.

#### Family SCHISTOSOMIDAE Looss, 1899

*Synonyms*.—Schistosomatidae Poche, 1907, p. 126; Bilharziidae Odhner, 1912, p. 58.

*Family diagnosis*.—Trematoda: Sexes separate, Pharynx absent; esophagus short, terminating posteriorly in a bifurcation to form intestinal branches or ceca which join caudally at the cecal union to form a single, slender intestinal cecum terminating near the posterior end of the body. Suckers present or absent; acetabulum, when pres-



ent, cephalad of the genital pore. Body of male may be widened caudad of the acetabulum and have the sides incurved ventrally, forming a gynaeophoric canal in which the female lies. Testes consist of four or more follicles. Cirrus pouch present or absent. Female more slender than male. Ovary elongate, sometimes spirally curved, and lying cephalad of the cecal union. Laurer's canal present or absent. Vitellaria extensive, extending from the distal pole of the ovary to the posterior end of the body. Parasitic in the blood vessels of birds and mammals.

*Type genus.*—*Schistosoma* Weinland, 1858.

KEY TO THE SUBFAMILIES OF SCHISTOSOMIDAE

- Females slender, more or less cylindrical in cross section; males larger than females, flattened, and with the lateral edges infolded, forming a gynaeophoric canal; intestinal ceca usually unite caudad of the equator of the body; testes situated cephalad of the cecal union.....**Schistosominae**, p. 3.
- Females similar to males in shape; males without well-developed gynaeophoric canal; cecal branches unite cephalad of the equator of the body; testes situated caudad of the cecal union.....**Bilharziellinae**, p. 25.

Subfamily SCHISTOSOMINAE Stiles and Hassall, 1898

*Synonym.*—Schistosomatinae Stiles and Hassall, 1926, p. 96.

*Subfamily diagnosis.*—Schistosomidae: Males flattened and with the lateral edges of the body infolded ventrally to form a gynaeophoric canal. Suckers present. Intestinal ceca long, usually uniting caudad of the equator of the body; common cecum relatively short. Testes situated in the anterior or posterior half of the body, always cephalad of the cecal union. Females slender, threadlike, either longer or shorter than the males. Uterus usually contains many eggs.

*Type genus.*—*Schistosoma* Weinland, 1858.

KEY TO THE GENERA OF SCHISTOSOMINAE

1. Either male or female unknown.....2.
- Male and female both known.....3.
2. Male unknown. Female slender, flattened; ovary spiral, in posterior third of body; intestinal ceca unite near the posterior end of the body; vitellaria consist of a few scattered follicles between the cecal branches; in birds.  
**Paraschistosomatium**, p. 15.
- Female unknown. Gynaeophoric canal well developed; testes numerous, in posterior third of body and cephalad of the cecal union; in mammals.  
**Heterobilharzia**, p. 14.
3. Testes 60 or more in number; ovary spiral, in anterior third of body.  
**Ornithobilharzia**, p. 17.
- Testes 20 or less in number; ovary equatorial or post-equatorial.....4.
4. Anterior end of gynaeophoric canal near the equator of body; testes in two rows, at anterior end of gynaeophoric canal; genital pore immediately in front of the anterior testis; intestinal ceca with short lateral diverticula; common cecum in both sexes short; ovary pre-equatorial.  
**Schistosomatium**, p. 12.

- Anterior end of gynaecophoric canal near acetabulum; genital pore of male a short distance caudad of acetabulum; intestinal ceca without diverticula; common cecum usually long; ovary pre-equatorial or post-equatorial in position -----5.
5. Testes less than 10 in number; ovary oval-----**Schistosoma**, p. 4.  
Testes 18 to 20 in number; ovary spiral-----6.
6. Anterior end of gynaecophoric canal slightly caudad of the acetabulum; oral sucker lacking in female; ovary situated about one-third of the body length from the posterior extremity -----**Austroilharzia**, p. 16.  
Anterior end of gynaecophoric canal cephalad of the acetabulum; oral sucker present in female; ovary pre-equatorial -----**Microilharzia**, p. 24.

### Genus SCHISTOSOMA Weinland, 1858

*Synonyms*.—*Gynaecophorus* Diesing, 1858, pp. 356–357; *Bilharzia* Cobbold, 1859, p. 364; *Thecosoma* Moquin-Tandon, 1860, p. 342.

*Generic diagnosis*.—Schistosominae: Preacetabular portion of male short, cylindrical or nearly so; postacetabular portion widened and with the edges inrolled ventrally forming a gynaecophoric canal. Cirrus pouch absent. Seminal vesicle present, pretesticular. Testes few in number (less than 10), situated at the beginning of the gynaecophoric canal. Female filiform, longer than male. Ovary elongated, in median line, usually caudad, rarely cephalad, of equator of body. Laurer's canal absent. Eggs oval, or spindle-shaped, not operculated, with terminal or lateral spine, or with a rudimentary lateral spine, and ultimately containing a ciliated miracidium. Parasitic in the blood vessels of mammals.

Larva a furcocercous, apharyngeal, spinose cercaria without eyespots; with paired group of penetration glands around the acetabulum; penetration gland ducts opening at the anterior end of the oral sucker and capped by hollow piercing spines; excretory system consisting of four or five pairs of flame cells, one pair of which is located in the base of the tail stem. Larval stages in snails.

*Type species*.—*Schistosoma haematobium* (Bilharz, 1852) Weinland, 1858.

#### KEY TO THE SPECIES OF SCHISTOSOMA<sup>1</sup>

1. Cuticle of male smooth; testes seven in number; ovary equatorial or post-equatorial; egg 74 $\mu$  to 106 $\mu$  long by 60 $\mu$  to 80 $\mu$  wide, with rudimentary lateral spine-----**S. japonicum**, p. 7.  
Cuticle of male tuberculate and spiny; testes more or less than seven in number; ovary usually post-equatorial, sometimes equatorial; egg with well-developed terminal or lateral spine-----2.
2. Intestinal ceca of male unite near equator, or cephalad of equator of body--3.  
Intestinal ceca of male unite caudad of equator of body-----4.

<sup>1</sup> *Schistosoma incognitum* Chandler, 1926, and *S. faradjei* are not included in this key, as the adults of these species are unknown. *S. faradjei* is a name proposed by Walkiers (1928) for a schistosome whose eggs were found in the feces of man in Africa, presumably the Belgian Congo. No characters are given except that the egg is unarmed. For description of the egg of *S. incognitum* see p. 12.

3. Intestinal ceca of male unite near junction of anterior and middle thirds of body; testes eight to nine in number; ovary in anterior half of body; egg  $120\mu$  to  $160\mu$  long by  $60\mu$  to  $70\mu$  wide, with well-developed lateral spine.

*S. mansoni*, p. 6.

Intestinal ceca of male unite near equator of body; testes four to five in number; ovary near junction of posterior and middle thirds of body; egg  $120\mu$  to  $150\mu$  long by  $40\mu$  to  $60\mu$  wide, with terminal spine.

*S. haematobium*, p. 5.

4. Testes three to six in number; ovary in posterior half of body; egg spindle-shaped, symmetrical,  $160\mu$  to  $180\mu$  long by  $50\mu$  to  $80\mu$  wide, with terminal spine-----*S. bovis*, p. 8.

Testes usually more than six in number; ovary near equator of body-----5.

5. Egg oval,  $92\mu$  to  $120\mu$  long by  $42\mu$  to  $72\mu$  wide, with terminal spine.

*S. indicum*, p. 11.

Egg spindle-shaped, asymmetrical,  $248\mu$  to  $400\mu$  long by  $52\mu$  to  $72\mu$  wide, with terminal spine-----*S. spindalis*, p. 9.

#### SCHISTOSOMA HAEMATOBIIUM (Bilharz, 1852) Weinland, 1858

Figures 1—4 b

*Synonyms*.—*Distoma haematobium* Bilharz, 1852, pp. 72–76 (in *Homo*, Egypt); *Gynaecophorus haematobius* (Bilharz, 1852) Diesing, 1858, pp. 356–357; *Bilharzia haematobia* (Bilharz, 1852) Cobbold, 1859, p. 364; *Bilharzia magna* Cobbold, 1859, p. 364; *Thecosoma haematobium* (Bilharz, 1852) Moquin-Tandon, 1860, p. 342; *Bilharzia capensis* Harley, 1864, p. 63; *Gynaecophorus magnus* (Cobbold, 1859) Stossich, 1892, p. 6; *Bilharzia haematobia hominis* Kowalewski, 1895, p. 26; *Bilharzia haematobia magna* (Cobbold, 1859) Kowalewski, 1895, p. 27.

*Specific diagnosis*.—*Schistosoma*:

*Male* 4 to 15 mm. long by about 1 mm. wide. Anterior part of body short, subcylindrical; posterior part long, flattened, and with lateral edges infolded ventrally, forming the gynaecophoric canal. Cuticle tuberculate and spiny. Oral sucker subterminal, elongated anteroposteriorly, and lined with fine spines; acetabulum circular, pedunculated, spiny, and situated a short distance caudad of oral sucker. Esophagus short and surrounded by esophageal glands; immediately in front of acetabulum the esophagus bifurcates to form the paired intestinal ceca, the two branches extending caudad to about the equator of the body, where they unite to form a common cecum, which terminates near the posterior end of the body. Testes 4 to 5 in number, situated dorsally near the beginning of the gynaecophoric canal. Seminal vesicle spherical, situated in front of the anterior testis. The genital pore opens in the median line at the beginning of the gynaecophoric canal.

*Female* about 20 mm. long, filiform, and with a maximum width of  $250\mu$ . Cuticle without spines, except in suckers and at posterior end of body. Digestive tract similar to that of male. Ovary elon-

gate, in posterior half of body, and cephalad of cecal union. Uterus long, ending posteriorly in a bulblike ootype, immediately posterior of which the shell gland, oviduct, and vitelline duct unite. Vitellaria composed of transversely elongated follicles situated on each side of the common cecum, extending from the cecal union to the posterior end of the body. Egg oval,  $120\mu$  to  $160\mu$  long by  $40\mu$  to  $60\mu$  wide, provided with a terminal spine.

*Cercaria furcocercous*, apharyngeal, spinose. Body, according to Faust (1926),  $140\mu$  to  $240\mu$  long by  $57\mu$  to  $100\mu$  wide; tail stem  $175\mu$  to  $250\mu$  long by  $35\mu$  to  $50\mu$  wide; furcal rami  $60\mu$  to  $100\mu$  long. Oral sucker  $64\mu$  long by  $60\mu$  wide; acetabulum small. Penetration glands consist of two pairs of large nucleated cells with granular acidophilic cytoplasm and three pairs with basophilic cytoplasm. Penetration gland ducts moderately thick, opening at the anterior end of oral sucker and capped by five pairs of hollow piercing spines. The germ cells lie caudad of acetabulum and consist of several large cells. The excretory system pattern consists of three pairs of flame cells in the body and one pair in the tail stem.

*Hosts*.—Primary, man, monkey (*Cercocebus atys* Audebert = *Cercopithecus fuliginosus*), and, experimentally, rats and mice; secondary, snails (*Bulinus contortus*, *B. dybowskii* and *B. innesi* in Egypt; *B. brochii* in Tunis; *Physopsis africana* in Belgian Congo, Natal, and Transvaal; *P. (?) globosa* in Nyasaland and Sierra Leone; *P. nasuta* in Tanganyika Territory; *Lymanaea natalensis* in South Africa; and *Planorbis dufourii* in Portugal).

*Location*.—Portal and mesenteric veins, and veins of bladder.

*Distribution*.—Africa, Australia, Asia (Arabia, Cyprus, India, Mesopotamia, Palestine, and Persia), and Europe (Greece and Portugal).

#### SCHISTOSOMA MANSONI Sambon, 1907

Figures 6-11

*Synonymys*.—*Distoma haematobium* Bilharz, 1852, in part; *Schistosomum americanum* Piraja da Silva, 1909, p. 294; *Bilharzia mansoni* (Sambon, 1907) Ascanio-Rodriguez, 1916, p. 92; *Distomum mansoni* (Sambon, 1907) Iturbe, 1917, p. 52.

*Specific diagnosis*.—*Schistosoma*:

*Male* about 10 mm. long by 1.2 mm. wide. Body form similar to that of *S. haematobium*. Cuticle tuberculate and spiny. Oral sucker subterminal; acetabulum pedunculated and situated about  $530\mu$  caudad of oral sucker. Esophagus surrounded by esophageal glands; intestinal ceca short, uniting in front of equator of body; common cecum very long, terminating near the posterior extremity of the body. Testes small, 8 to 9 in number, situated at anterior end of

gynaecophoric canal. Seminal vesicle small, in front of testes. Genital pore opens in median line about the level of the first testis.

*Female* 15 mm. long, filiform, and about  $170\mu$  wide. Suckers small; acetabulum situated about  $224\mu$  to  $252\mu$  caudad of the oral sucker. Digestive system similar to that of male. Ovary elongate, in anterior half of body and immediately in front of cecal union. Uterus short and usually containing but one egg at a time. The vitellaria occupy about two-thirds of body length, extending posteriorly from immediately caudad of cecal union. Egg oval,  $120\mu$  to  $160\mu$  long by  $60\mu$  to  $70\mu$  wide, and provided with a strong lateral spine.

*Cercaria* furecocercous, apharyngeal, spinose. Body  $140\mu$  to  $190\mu$  long by  $50\mu$  to  $75\mu$  wide; tail stem  $200\mu$  to  $260\mu$  long by  $25\mu$  to  $40\mu$  wide; furcal rami  $50\mu$  to  $75\mu$  long. Oral sucker  $30\mu$  to  $60\mu$  wide; acetabulum small. Penetration glands consist of two pairs of large nucleated acidophilic, granular cells and four pairs with small nuclei and basophilic cytoplasm; penetration gland ducts very thick, opening at the anterior end of oral sucker and capped by six pairs of hollow piercing spines. Germ cells small and situated caudad of acetabulum. Excretory system pattern consists of three pairs of flame cells in the body and one pair in the tail stem.

*Hosts*.—Primary, man, and experimentally, rats and mice; secondary, snails (*Planorbis boissyi* in Egypt; *Planorbis pfeifferi*, *Physopsis africana* and *Bulinus tropicus* in South Africa; *Planorbis guadelupensis* in Venezuela; *Planorbis centimetralis* and *P. olivaceus* in Brazil; and *P. antiguensis* in the West Indies).

*Location*.—Mesenteric veins.

*Distribution*.—Africa, South America, and West Indies.

#### SCHISTOSOMA JAPONICUM Katsurada, 1904

Figs. 12-16

*Synonyms*.—*Schistosoma cattoi* R. Blanchard in Catto, 1905, p. 70-73; *Bilharzia japonica* (Katsurada, 1904) Hutyra and Marek, 1913, p. 1128.

*Specific diagnosis*.—*Schistosoma*:

*Male* 9.5 to 17.8 mm. long by  $557\mu$  to  $967\mu$  wide. Cuticle smooth except for small spines along gynaecophoric canal and in suckers. Oral sucker subterminal,  $200\mu$  to  $350\mu$  in diameter; acetabulum pedunculated,  $156\mu$  to  $420\mu$  in diameter, situated  $550\mu$  to  $780\mu$  caudad of oral sucker. The digestive tract is similar to that of *S. haematobium*; intestinal caeca unite caudally about one-fourth of body length from posterior extremity of body. Testes 7 in number (6 to 8 according to some authors), situated near anterior end of gynaecophoric canal. Seminal vesicle spherical,  $125\mu$  in diameter, and situated immediately in front of the first testis.

*Female* 15 to 20 mm. long and  $312\mu$  to  $358\mu$  wide at the cecal union. Cuticle smooth. Oral sucker subterminal,  $60\mu$  to  $70\mu$  in diameter; acetabulum pedunculated,  $45\mu$  to  $60\mu$  in diameter, situated  $266\mu$  to  $298\mu$  caudad of oral sucker. Ovary elongate,  $580\mu$  to  $700\mu$  long by  $135\mu$  to  $185\mu$  wide, situated at equator, or caudad of equator of body. Uterus long and containing numerous eggs. Genital pore immediately caudad of acetabulum. Vitellaria occupy the space from the cecal union to the posterior end of the body, and are composed of transversely elongated follicles lying on both sides of the common cecum. Egg oval,  $74\mu$  to  $106\mu$  long by  $60\mu$  to  $80\mu$  wide, provided with a small, lateral, hooked or rudimentary spine.

*Cercaria* furcocercous, apharyngeal, spinose. Body  $100\mu$  to  $160\mu$  long by  $40\mu$  to  $66\mu$  wide; tail stem  $140\mu$  to  $160\mu$  long by  $20\mu$  to  $35\mu$  wide; furcal rami  $50\mu$  to  $75\mu$  long. Oral sucker  $54\mu$  long by  $33\mu$  wide; acetabulum small. Penetration glands consist of five pairs of large nucleated cells with granular, acidophilic cytoplasm; penetration gland ducts very thick, opening at anterior end of oral sucker and capped by five pairs of hollow piercing spines. The germ cells consist of a clustered mass immediately caudad of the acetabulum. The excretory system pattern consists of three pairs of flame cells in the body and one pair in the tail stem.

*Hosts*.—Primary, man, *Bos sinicus*,<sup>2</sup> cattle (*Bos taurus*), dog, cat, horse, swine, sheep, and experimentally, guinea pigs, monkeys, rabbits, rats, and mice; secondary, snails (*Katayama nosophora* and *K. n. yoshidai* in Japan; *K. formosana* in Formosa; *Oncomelania (Hemibia) lupensis*, *Katayama fausti* and *K. f. cantoni* in China).

*Location*.—Portal and mesenteric veins.

*Distribution*.—Asia (China, Japan, Formosa, and Philippine Islands) and Africa.

SCHISTOSOMA BOVIS (Sonsino, 1876) R. Blanchard, 1895

Figures 23-25

*Synonyms*.—*Bilharzia bovis* Sonsino, 1876, pp. 84-87 (in *Bos taurus*: Egypt); *Bilharzia crassa* Sonsino, 1878, p. 652; *Bilharzia ovis* Cobbold, 1885, p. 499; *Gynaecophorus crassus* (Sonsino, 1878) Stossich, 1892, p. 6; *Gynaecophorus bovis* (Sonsino, 1876) Railliet, 1893, p. 375; *Bilharzia haematobia crassa* (Sonsino, 1878) Kowalewski, 1895, pp. 18, 19, 27; *Schistosoma crassum* (Sonsino, 1876) Looss, 1899, pp. 657, 658.

*Specific diagnosis*.—*Schistosoma*:

*Male* 9 to 14 mm. long. Cuticle with tubercles and spines. Oral sucker subterminal,  $230\mu$  long and  $150\mu$  deep; acetabulum  $420\mu$  in

<sup>2</sup> Brumpt (Précis de Parasitologie, ed. 3 (1922), p. 398) gives *Bos sinicus* as a host for *Schistosoma japonicum*. This host name is not recognized by mammalogists, and since no geographical locality is given, its identity is problematical.

diameter. Esophagus  $500\mu$  long; cecal branches unite posteriorly at the beginning of the posterior fourth of the body and may show two or three anastomoses before their final union; common cecum terminates near posterior end of body. Testes 3 to 6 in number (usually 4, according to Khalil (1924)), each  $120\mu$  long by  $100\mu$  wide, in a row on dorsal aspect of body, caudad of acetabulum. Seminal vesicle pear-shaped,  $80\mu$  in diameter, and situated immediately in front of the anterior testis. Cirrus pouch and prostate absent. Genital pore slightly salient and situated immediately caudad of the acetabulum.

*Female* 12 to 17 mm. long, cylindrical, and attenuated at the extremities. Cuticle smooth and without spines. Oral sucker small,  $40\mu$  in diameter; acetabulum usually retracted,  $50\mu$  in diameter. Intestinal ceca unite caudally at the posterior fourth of body; common cecum relatively short and terminating about  $160\mu$  from posterior extremity. Ovary elongated,  $300\mu$  long and  $150\mu$  wide, and situated immediately in front of cecal union. Shell gland small and ill-defined, situated in front of anterior pole of ovary. Uterus long and containing numerous eggs. Vitellaria consist of elongate, densely packed follicles beginning about  $100\mu$  caudad of ovary and extending about  $200\mu$  from posterior extremity. Egg spindle-shaped, symmetrical,  $160\mu$  to  $180\mu$  long by  $50\mu$  to  $60\mu$  wide, and provided with a blunt spine at one pole.

*Hosts*.—Primary, mammals (*Bos taurus*, *Ovis aries* and (?) man); secondary, snails (*Physopsis africana* in South Africa, the host of *Cercaria octadena* which is regarded by Faust (1926) as the larva of *S. bovis*).

*Location*.—Portal and intestinal veins.

*Distribution*.—Europe (Italy, Sardinia, and Sicily), Asia (India, Annam, and Malay States), and Africa (Egypt and South Africa).

SCHISTOSOMA SPINDALIS Montgomery, 1906

Figures 17-22

*Synonym*.—*Bilharzia spindalis* (Montgomery, 1906) Odhner, 1912, p. 59.

*Specific diagnosis*.—*Schistosoma*:

*Male* 8.24 to 9.58 mm. long by  $527\mu$  thick (4.5 to 12.2 mm. long by  $250\mu$  to  $667\mu$  wide, according to Vryburg (1907)). Cuticle covered with tubercles and spines; spines are also present in suckers and at borders of gynaecophoric canal. Oral sucker  $306\mu$  in diameter; acetabulum pedunculated,  $357\mu$  in diameter, and situated  $900\mu$  caudad of oral sucker. (Oral sucker  $300\mu$  by  $250\mu$ ; acetabulum  $267\mu$  in diameter and  $767\mu$  caudad of oral sucker, according to Vryburg.) Testes 6 to 7 in number, each  $85\mu$  in diameter. Caudal end of body terminates in a conical projection and at the apex is located the excretory pore.

*Female* 14.1 mm. long by  $200\mu$  wide (7.17 to 7.25 mm. long by  $100\mu$  to  $175\mu$  wide, according to Vryburg). Cuticle devoid of spines except at the posterior end of body and in cavity of oral sucker. Oral sucker subterminal,  $68\mu$  in diameter; acetabulum small, retracted, and situated  $268\mu$  caudad of the oral sucker. Esophagus simple; intestinal caeca unite posteriorly 7.702 mm. caudad of esophageal bifurcation; common cecum 6 mm. long and terminating  $144\mu$  from posterior end of body. Ovary oval and situated posterior of equator of body. Vitellaria are composed of discrete follicles lying lateral to the common cecum and extending posteriorly from the cecal union to within a short distance of the posterior extremity of the body. Egg spindle-shaped, asymmetrical, with a spine  $14\mu$  to  $15\mu$  long present at one pole; uterine egg  $284\mu$  long by  $44\mu$  wide; immature egg, in which embryo is not defined,  $304\mu$  to  $316\mu$  long and  $52\mu$  to  $54\mu$  wide; mature egg, containing a miracidium,  $364\mu$  to  $400\mu$  long by  $68\mu$  to  $72\mu$  wide at the widest portion and  $12\mu$  to  $14\mu$  across the polar prolongations.

*Cercaria* furcocercous, apharyngeal, spinose. Total length  $490\mu$ ; body  $200\mu$  long by  $50\mu$  wide; tail stem  $290\mu$  long by  $30\mu$  wide; furcal rami  $100\mu$  long. Oral sucker  $60\mu$  long by  $40\mu$  wide; acetabulum  $20\mu$  in diameter. Penetration glands consist of five pairs of pyriform cells, the two anterior pairs being acidophilic, coarsely granular, and with large nuclei and the posterior three pairs being finely granular, basophilic, and with somewhat larger nuclei. Penetration gland ducts thick, opening at anterior end of oral sucker, and capped by five pairs of hollow piercing spines. The germ cells, 24 in number, lie caudad of acetabulum. The excretory system pattern consists of four pairs of flame cells in the body and one pair in the tail stem.

*Hosts*.—Primary, mammals (*Bos* (*Bubalus*) *bubalis* Linnaeus, 1766 (synonym, *Buffelus indicus* Rutimeyer, 1865=*Bos indicus*)) and man, and, experimentally, goat, water buffalo, monkey (*Macaca sinica*), guinea pig, and rats; secondary, snails (*Planorbis exustus* and, rarely, *Lymnaea acuminata* in India; *Planorbis pfeifferi* and *Bulinus tropicus* in Africa).

*Location*.—Mesenteric and portal veins.

*Distribution*.—Asia (India and Sumatra) and Africa (South Africa).

Recently Porter (1926) described a new variety of *Schistosoma spindalis* from South Africa for which she proposed the name *S. spindalis* variety *africana*. The characters upon which the new variety is based are the egg size, smaller than that described by Montgomery for the Indian species, and also a cercaria smaller than that described by Soparkar (1921). The eggs of the new variety were obtained from the urine of man and measured  $163\mu$  to  $258\mu$



long by  $46.4\mu$  to  $70\mu$  wide. The cercaria, obtained by infecting *Planorbis pfeifferi* and *Bulinus tropicus*, measured as follows: Body  $153.3\mu$  to  $183\mu$  long by  $50.8\mu$  to  $86.6\mu$  wide; tail stem  $173.3\mu$  to  $200\mu$  long by  $50.8\mu$  to  $86.6\mu$  wide; furcal rami  $66.6\mu$  to  $83.3\mu$  long by  $21\mu$  to  $26.6\mu$  wide; oral sucker  $40\mu$  to  $53.3\mu$  long by  $30\mu$  to  $33\mu$  wide; acetabulum  $18.5\mu$  by  $26.6\mu$ .

The reported occurrence of *S. spindalis* in man includes at least three apparently authentic cases, one reported by Cawston (1925) and two by Porter, and there are one or two doubtful cases. Daubney (1923) considers the egg reported from the urine of a Madras native by Christophers and Stephens (1905) as probably belonging to this species. It is possible that the eggs described from human urine by Chesterman (1923) may also be those of *S. spindalis*.

SCHISTOSOMA INDICUM Montgomery, 1906

Figures 26-29

*Synonymy*.—*Bilharzia indica* (Montgomery, 1906) Hutyrá and Marek, 1910, p. 902.

*Specific diagnosis*.—*Schistosoma*:

*Male* 8.35 to 17 mm. long; anterior part of body straight, 1 to 1.5 mm. long and  $400\mu$  wide; posterior part of body cylindrical due to inrolling of the edges to form the gynaecophoric canal; maximum dorsal width  $350\mu$  and greatest dorsoventral width  $400\mu$  to  $500\mu$ . Cuticle tuberculate and spiny. Oral sucker subterminal, infundibuliform,  $270\mu$  to  $320\mu$  in diameter; acetabulum pedunculated,  $350\mu$  to  $425\mu$  in diameter, and situated 0.9 to 1.5 mm. caudad of oral sucker. Esophagus  $425\mu$  long; cecal branches unite caudally about 0.85 to 1.5 mm. from posterior end of body, forming a common cecum which terminates about  $100\mu$  from the posterior extremity. Testes 5 to 9 in number, situated about  $400\mu$  caudad of acetabulum; seminal vesicle small,  $85\mu$  in diameter and lying in front of the first testis; the genital pore opens in the median line at the anterior end of the gynaecophoric canal. The excretory bladder is  $80\mu$  long; excretory pore terminal.

*Female* 9 to 22 mm. long and  $190\mu$  wide. Cuticle smooth except for a few spines on the posterior end of body and on the inside of suckers. Oral sucker small, subterminal; acetabulum  $50\mu$  to  $60\mu$  in diameter, usually retracted. Esophagus  $230\mu$  long; cecal branches unite caudad of ovary, forming a slender common cecum which terminates about  $200\mu$  from the posterior extremity. Ovary situated at equator of body, oval in shape,  $500\mu$  to  $750\mu$  long by  $100\mu$  wide; uterus 5 to 7 mm. long; genital pore immediately caudad of acetabulum. Vitellaria lie on each side of the common cecum and extend from the cecal union to  $200\mu$  to  $300\mu$  from the posterior end of body. Egg oval and provided with a spine at one pole; uterine egg from  $92\mu$

to  $100\mu$  long by  $42\mu$  to  $44\mu$  wide, spine  $14\mu$  long; mature egg in tissue from  $120\mu$  to  $140\mu$  long by  $68\mu$  to  $72\mu$  wide.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, mammals (*Equus caballus*, *E. asinus*, *Camelus dromedarius*, and *Ovis aries*); secondary, unknown.

*Location*.—Mesenteric, pancreatic, pelvic, portal, and hepatic veins.

*Distribution*.—India.

Specimens of schistosomes from sheep (United States National Museum Helminthological Collections No. 14828), from Lahore, India, donated by Capt. S. H. Gaiger, have been studied and identified as *Schistosoma indicum*. The males measure 5.9 to 7.6 mm. long by  $484\mu$  to  $718\mu$  wide. The anterior part of the body is subcylindrical,  $546\mu$  to  $692\mu$  long and  $235\mu$  wide. Oral sucker subterminal,  $172\mu$  to  $187\mu$  in diameter; acetabulum pedunculated,  $187\mu$  to  $203\mu$  in diameter, and situated  $156\mu$  to  $312\mu$  caudad of oral sucker. Testes nine in number, each elongated dorsoventrally and with their edges in apposition, and situated dorsally at the anterior end of the gynaecophoric canal; an oval seminal vesicle  $109\mu$  long by  $62\mu$  to  $78\mu$  wide is situated in front of the anterior testis.

The females measure 7.3 to 14.5 mm. long by  $172\mu$  wide. Oral sucker and acetabulum equal in size,  $30\mu$  in diameter; the acetabulum is situated about  $170\mu$  caudad of oral sucker. Ovary elongated,  $525\mu$  to  $572\mu$  long by  $95\mu$  to  $125\mu$  wide, and situated caudad of equator of body. The uterus is long and filled with eggs. Vitellaria occupy the entire space from the cecal union to the posterior end of the body. Uterine egg oval,  $86\mu$  to  $91\mu$  long by  $43\mu$  to  $47\mu$  wide, and provided with a terminal spine  $12\mu$  long.

#### SCHISTOSOMA INCOGNITUM Chandler, 1926

Figure 5

*Specific diagnosis*.—*Schistosoma*:

*Male* unknown.

*Female* unknown. Egg  $95\mu$  to  $100\mu$  long by  $41.5\mu$  to  $50\mu$  wide, with a subterminal spine  $7.3\mu$  long.

*Cercaria* unknown or unrecognized.

*Host*.—Primary, mammals (man); secondary, unknown.

*Location*.—Feces (for eggs).

*Distribution*.—Asia (India).

#### Genus SCHISTOSOMATIUM Tanabe, 1923

*Generic diagnosis*.—Schistosominae: Male larger and longer than female. Suckers present, well developed. Anterior two-fifths of body flattened; posterior three-fifths infolded to form the gynae-

cophoric canal. Intestinal ceca provided with lateral diverticula and united near posterior end of body. Testes 14 to 18 in number, arranged in two rows at anterior end of gynaecophoric canal. Genital pore median, in front of the anterior testis. Female flattened. Ovary in anterior half of body. Uterus containing numerous oval, spineless eggs. Genital pore caudad of acetabulum. Vitellaria composed of lobulated, densely packed follicles extending from the distal pole of ovary to posterior end of body.

Larva a furcocercous, apharyngeal cercaria, with eye spots, and with an excretory system consisting of six pairs of flame cells, one pair of which is located in the base of the tail stem.

*Type species.*—*Schistosomatium pathlopticum* Tanabe, 1923.

SCHISTOSOMATIUM PATHLOPTICUM Tanabe, 1923

Figures 30–32

*Synonym.*—*Schistosoma pathlopticum* Tanabe in Strong, 1923, p. 516.

*Specific diagnosis.*—*Schistosomatium*:

*Male* 5.6 to 11.8 mm. long by  $400\mu$  to  $900\mu$  wide. Anterior portion of body flattened, 2.4 to 4.7 mm. long by  $260\mu$  to  $580\mu$  wide; posterior portion, 3.2 to 7.1 mm. long by 1.04 mm. wide when flattened, with edges infolded forming a gynaecophoric canal; between the anterior and posterior portions the body is narrowed and is  $240\mu$  to  $410\mu$  wide. Cuticle spiny but without tubercles. Oral sucker subterminal,  $130\mu$  to  $160\mu$  in diameter; acetabulum pedunculated,  $250\mu$  to  $260\mu$  in diameter. Esophagus simple, about  $520\mu$  long; intestinal ceca provided with short lateral diverticula and united posteriorly about  $600\mu$  from the caudal extremity; common cecum short and terminating about  $140\mu$  from posterior end of body. Testes 14 to 18 in number, spherical,  $100\mu$  to  $180\mu$  in diameter, in two parallel rows in the median line and slightly pre-equatorial. Seminal vesicle large, semi-lunar in outline, and situated to the left of the median line. Genital pore situated at anterior end of gynaecophoric canal, slightly to left of median line. Excretory system consists of two slender, lateral tubes which unite to form a common tube opening slightly dorsad at the extreme posterior end of body.

*Female* 4.5 to 10.2 mm. long by  $180\mu$  to  $380\mu$  wide. Suckers weak and rudimentary. Cuticle spiny in anterior part of body, especially around suckers and genital pore. Ovary oval in shape and situated in front of equator of body. Shell gland poorly defined, in front of ovary, and at the junction of the oviduct, vitelline duct, and uterus. Uterus about  $500\mu$  long and filled with eggs. Vitellaria composed of densely packed lobulated follicles, and occupying almost the entire

space from the ovary to the posterior end of the body. Egg oval,  $59\mu$  long by  $40\mu$  wide, without spine.

*Cercaria furcocercous*, apharyngeal, spinose. Total length  $410\mu$ ; body  $180\mu$  long by  $80\mu$  wide; tail stem  $230\mu$  long by  $45\mu$  wide; furcal rami  $100\mu$  long. Eyespots present, pigmented,  $8\mu$  in diameter, lying near equator of body. Oral sucker  $50\mu$  long by  $47\mu$  wide; acetabulum  $24\mu$  in diameter. Penetration glands consist of three pairs of acidophilic cells which nearly fill the postacetabular region of body; penetration gland ducts open at anterior end of acetabulum and are capped by an equal number of hollow piercing spines. The germ cells lie in the median line caudad of the acetabulum. Excretory system pattern consists of five pairs of flame cells in the body and one pair in the tail stem.

*Hosts*.—Primary, mammals (white rats and mice, experimentally); secondary, snail (*Lymnaea palustris*).

*Location*.—Intestinal veins, portal vein, and liver.

*Distribution*.—North America (United States (Boston, Massachusetts)).

#### HETEROBILHARZIA, new genus

*Generic diagnosis*.—Schistosominae: Preacetabular portion of male short, subcylindrical; posterior portion with edges inrolled, forming a deep gynaeophoric canal. Suckers present. Cuticle covered with small tubercles. Intestinal ceca unite caudally near posterior end of body. Testes numerous, 70 to 83 in number, arranged in two irregular rows in posterior third of body anterior to cecal union. Cirrus pouch present and containing the seminal vesicle. Genital pore situated at the beginning of the gynaeophoric canal and to the left of the median line. Female unknown.

*Type species*.—*Heterobilharzia americana*, new species.

#### HETEROBILHARZIA AMERICANA, new species

Figures 33-34

*Specific diagnosis*.—*Heterobilharzia*:

*Male* 10 to 14 mm. long by 3 mm. wide. Cuticle covered with small tubercles. Oral sucker subterminal,  $350\mu$  to  $355\mu$  in diameter; acetabulum pedunculated,  $426\mu$  to  $453\mu$  in diameter, situated about  $568\mu$  caudad of oral sucker. Esophagus long and surrounded by the esophageal glands; intestinal ceca sinuous and uniting about  $500\mu$  to  $750\mu$  from posterior end of body; common cecum short and terminating  $140\mu$  to  $150\mu$  from posterior end of body. Testes 70 to 83 in number, arranged in two irregular rows between the intestinal ceca in posterior third of body. Cirrus pouch elongated transversely,  $210\mu$  to  $315\mu$  long by  $70\mu$  wide, and situated about  $568\mu$  caudad of

acetabulum; seminal vesicle oval and lying entirely within the cirrus pouch. Genital pore  $570\mu$  caudad of acetabulum and to the left of median line. Excretory system consists of a short bladder which opens at excretory pore at the tip of the body, and of two slender branches extending cephalad on each side of body.

*Female* unknown.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, mammals (*Lynx* species, probably *L. uinta*); secondary, unknown.

*Location*.—Mesenteric veins.

*Distribution*.—North America (United States (Washington, D. C., National Zoological Park)).

*Type specimens*.—United States National Museum Helminthological Collections No. 14532, collected August 27, 1907, by Dr. M. C. Hall and Dr. A. Hassall.

#### PARASCHISTOSOMATIUM, new genus

*Generic diagnosis*.—Schistosominae: Male unknown. Female slender, flattened, and tapering toward the extremities. Cuticle smooth. Oral sucker subterminal, well developed; acetabulum pedunculated. Esophagus simple; intestinal ceca without lateral diverticula and united caudally near posterior end of body; common cecum very short. Ovary spirally curved, in posterior third of body; uterus long and filled with eggs. Vitelline follicles few in number, situated posterior to ovary and between the cecal branches.

*Type species*.—*Paraschistosomatium anhingae*, new species.

#### PARASCHISTOSOMATIUM ANHINGAE, new species

Figure 35

*Specific diagnosis*.—*Paraschistosomatium*:

*Male* unknown.

*Female* 6.9 mm. long by  $325\mu$  wide. Body flattened and tapering gradually toward the extremities. Cuticle smooth and without spines except in suckers. Suckers equal in size,  $143\mu$  in diameter; oral sucker subterminal; acetabulum pedunculated and situated  $480\mu$  caudad of oral sucker. Esophagus simple, bifurcating in front of acetabulum; intestinal ceca unite caudally about  $460\mu$  from posterior end of body; common cecum  $200\mu$  long. Ovary spiral,  $585\mu$  long as measured in a straight line and exclusive of length of spiral, and situated in the anterior part of the posterior third of body. Vitellaria consist of a few scattered follicles lying posterior to the ovary and between the cecal branches. Genital pore is situated immediately caudad of the acetabulum. Uterus long and filled with thin-shelled eggs which measure about  $70\mu$  long by  $43\mu$  wide.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Anhinga anhinga*); secondary, unknown.

*Location*.—Portal vein.

*Distribution*.—North America (United States (Texas)).

*Type specimen*.—United States National Museum Helminthological Collections No. 27887, collected by the writer, April 8, 1922, at Bryan, Tex.

This trematode is probably more closely related to species of the genus *Schistosomatium* than those of any of the other genera. The union of the intestinal ceca near the posterior end of the body is similar to that in *S. pathlopticum*; in *P. anhingae*, however, the ceca do not have lateral diverticula, the ovary is more posterior, and the distribution of the vitelline follicles is very different from that in *S. pathlopticum*. In view of these differences the writer has tentatively proposed the new genus *Paraschistosomatium* to include this species.

#### Genus AUSTROBILHARZIA Johnston, 1917

*Generic diagnosis*.—Schistosominae: Male shorter than female. Gynaecophoric canal extends from posterior edge of acetabulum to posterior end of body. Suckers well developed and prominent. Esophagus bifurcates in front of acetabulum; intestinal ceca unite caudally in the posterior fourth of body and may show several anastomoses before the final union; common cecum short. Testes 18 to 20 in number, situated between the ceca, originating anteriorly a short distance caudad of acetabulum and extending to equator of body. Genital pore situated caudad of acetabulum, a little to the left of median line. Cirrus pouch present, enclosing the seminal vesicle and prostate. Female slender, the anterior portion thread-like and the posterior portion flattened. Oral sucker not developed, acetabulum present. Ovary long and loosely spiral. Vitellaria well developed and occupying the region behind the ovary.

*Type species*.—*Austrobilharzia terrigalensis* Johnston, 1917.

#### AUSTROBILHARZIA TERRIGALENSIS Johnston, 1917

##### Figure 36

*Specific diagnosis*.—*Austrobilharzia*:

*Male* 3.5 to 4 mm. long by 400 $\mu$  wide dorsoventrally. Cuticle smooth. Suckers about equal in size, 175 $\mu$  in diameter; acetabulum pedunculated and lined with fine spines. Intestinal ceca provided with small diverticula; in the posterior third of the body the ceca are united by commissures, forming two loops which are separated by a short stem; common cecum short and terminating near posterior end of body. Testes 18 to 20 in number, symmetrically placed between the intestinal ceca, originating about 200 $\mu$  caudad of genital pore and extending

to equator of body. Cirrus pouch moderately developed and enclosing the seminal vesicle and prostate. Genital pore situated about  $125\mu$  caudad of the acetabulum and to the left of the median line. The excretory system consists of a Y-shaped vesicle opening at the extreme posterior end of the body, with two fine ciliated tubes given off from the anterior limbs of the Y.

*Female* 4.5 to 5 mm. long; anterior part of body slender, 2.65 mm. long by  $58\mu$  in diameter; posterior portion flattened, 1.85 mm. long by  $136\mu$  wide. Oral sucker absent; acetabulum pedunculated,  $35\mu$  in diameter. Oral opening ventral,  $30\mu$  from the anterior end of body; esophagus  $200\mu$  long; intestinal ceca unite caudally at the union of anterior and posterior parts of body; common cecum slender and terminating near posterior end of body. Ovary spirally curved,  $388\mu$  long when measured in a straight line, disregarding spiral length, and situated at the union of anterior and posterior parts of body. The oviduct extends forward and widens near its anterior end to form the uterus which contains a single egg. The genital pore is situated immediately behind and to one side of the acetabulum. The vitellaria occupy the space from the distal pole of the ovary to the posterior end of the body. Egg  $32\mu$  long by  $26\mu$  wide.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Hydrocoloeus novae-hollandiae* = *Larus novae-hollandiae*); secondary, unknown.

*Location*.—Intestinal blood vessels.

*Distribution*.—Australia (New South Wales).

#### Genus ORNITHOBILHARZIA Odhner, 1912

*Synonym*.—*Macrobilharzia* Travassos, 1923, p. 18.

*Generic diagnosis*.—Schistosominae: Female shorter than male. Male with well developed gynaecophoric canal, formed by an infolding of the lateral edges of the body. Suckers present. Cuticle covered with spines. Digestive tract similar to that of *Schistosoma*; intestinal ceca long and showing a tendency to form several anastomoses before finally uniting to form the common cecum. Testes numerous (60 or more), commencing a short distance caudad of acetabulum, and extending into posterior half of body. Cirrus pouch rudimentary or absent. Seminal vesicle free in the parenchyma; prostate absent. Genital pore small and situated immediately caudad of acetabulum. Female elongate, slender, and flattened. Ovary elongated, loosely or tightly coiled, and situated in anterior third of body. Vitellaria extensive, occupying about two-thirds of body length. Laurer's canal present (at least in some species). Uterus short and containing but one egg at a time.

*Type species*.—*Ornithobilharzia intermedia* Odhner, 1912.

KEY TO SPECIES OF ORNITHOBILHARZIA <sup>3</sup>

1. Parasitic in mammals-----2.  
 Parasitic in birds-----3.
2. Cuticle of male smooth; testes 70 to 80 in number; egg  $72\mu$  to  $74\mu$  by  $22\mu$  to  $26\mu$ , with a spinous process at each pole-----*O. turkestanicum*, p. 21.  
 Cuticle of male tuberculate; testes 61 in number; egg  $100\mu$  to  $136\mu$  by  $44\mu$  to  $60\mu$ , with a spine at one pole-----*O. bomfordi*, p. 22.
3. Species inadequately described-----4.  
 Species adequately described-----5.
4. Male 14 mm. long; oral sucker  $364\mu$  in diameter; acetabulum  $560\mu$  in diameter; female unknown; in *Hydrocoloeus melanocephalus*.  
*O. kowalewskii*, p. 19.  
 Male 16 mm. long; oral sucker  $312\mu$  by  $104\mu$  to  $160\mu$ ; acetabulum  $450\mu$  in diameter; female shorter than male; in *Thalasseus maximus* (= *Sterna galericulata*)-----*O. canaliculata*, p. 19.
5. Male 40 to 57 mm. long; testes 230 to 250 in number; female unknown.  
*O. macrobilharzia*, p. 21.  
 Male 11 mm. or less in length; female known-----6.
6. Male 8 to 10.6 mm. long; testes 90 to 110 in number; intestinal ceca in female unite posteriorly immediately caudad of ovary-----*O. intermedia*, p. 18.  
 Male 6 to 7 m. long; testes 65 in number; intestinal ceca unite posteriorly a considerable distance caudad of ovary-----*O. odhneri*, p. 20.

## ORNITHOBILHARZIA INTERMEDIA Odhner, 1912

Figure 39

*Specific diagnosis.*—*Ornithobilharzia*:

*Male* 8 to 10.6 mm. long and  $420\mu$  wide. Cuticle provided with thick blunt spines. Oral sucker  $200\mu$  to  $250\mu$  in diameter; acetabulum  $300\mu$  to  $350\mu$  in diameter. Testes 90 to 110 in number, commencing a short distance caudad of acetabulum and extending almost to posterior fourth of body; terminal portion of genital system (Endapparat) small and situated at posterior edge of acetabulum; seminal vesicle entirely outside of a rudimentary cirrus pouch; prostate absent. The genital pore is situated immediately caudad of the acetabulum and to the left of the median line.

*Female* 4.5 to 5.75 mm. long and  $170\mu$  to  $220\mu$  wide in region of ovary. Cuticle spiny. Oral sucker  $40\mu$  to  $50\mu$  in diameter; acetabulum  $25\mu$  to  $35\mu$  in diameter. Ovary long, spirally twisted, and situ-

<sup>3</sup> While this paper was in preparation, Linton (1928) described an *Ornithobilharzia* species from several water birds at Woods Hole, Mass. The writer has recently examined specimens of this species which were deposited in the U. S. National Museum, and also several additional specimens which Professor Linton kindly loaned for study. In this material there appear to be two species represented. The specimen (Cat. No. 7946, U. S. N. M.) from *Larus argentatus* is a species of *Ornithobilharzia*, but owing to the fact that the female is inclosed in the gynaecophoric canal of the male, it is impossible to make out the necessary specific characters. The remaining specimens, with the possible exception of the one from *Nycticorax nycticorax naevius* (which is in such a poor state of preservation that none of the structures can be made out) appear to be closely related to, if not identical with, *Microbilharzia chapini*. The males of these specimens are somewhat more robust than *M. chapini* from *Marila affinis*, but are otherwise very similar.



ated in the anterior fourth of body. Vitellaria extend from a short distance caudad of ovary to posterior end of body. Egg  $70\mu$  long by  $50\mu$  wide.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Larus fuscus* and *Hydrocoloeus melanocephalus*); secondary, unknown.

*Location*.—Intestinal veins.

*Distribution*.—Europe (Sweden).

**ORNITHOBILHARZIA CANALICULATA (Rudolphi, 1819) Odhner, 1912**

Figure 40

*Synonyms*.—*Distoma canaliculatum* Rudolphi, 1819, p. 676 (in *Sterna* species; Brazil); *Bilharziella canaliculata* (Rudolphi, 1819) Braun, 1902, p. 142.

*Specific diagnosis*.—*Ornithobilharzia*:

*Male* 16 mm. long and from 1 to 1.4 mm. wide. Oral sucker subterminal,  $312\mu$  long by  $104\mu$  to  $106\mu$  wide; acetabulum pedunculated,  $450\mu$  in diameter and  $100\mu$  to  $150\mu$  in height, and situated about 1 mm. caudad of oral sucker. Testes numerous, originating caudad of copulatory apparatus and extending posteriorly to equator of body. The genital pore is situated in anterior part of gynaecophoric canal. The cirrus pouch (?) lies at a right angle to the long axis of the body.

*Female* shorter than male, cylindrical, and thinner anteriorly than posteriorly, the anterior part of body being about  $60\mu$  wide and the posterior part about  $145\mu$  wide.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Thalasseus maximus*=*Sterna galericulata*); secondary, unknown.

*Location*.—Intestine (probably from intestinal veins).

*Distribution*.—South America (Brazil).

**ORNITHOBILHARZIA KOWALEWSKII (Parona and Ariola, 1896), Odhner, 1912**

Figures 41–42

*Synonyms*.—*Bilharzia kowalewskii* Parona and Ariola, 1896, pp. 114–116 (in *Larus melanocephalus*; Italy); *Schistosoma kowalewskii* (Parona and Ariola, 1896) Railliet, 1899, p. 788; *Bilharziella kowalewskii* (Parona and Ariola, 1896) Looss, 1899, p. 658.

*Specific diagnosis*.—*Ornithobilharzia*:

*Male* 14 mm. long by 1 mm. wide. Oral sucker cuplike, subterminal, smaller than acetabulum, and measuring  $364\mu$  in diameter; acetabulum pedunculated, circular,  $560\mu$  in diameter. Cuticle without tubercles or spines. Esophagus bifurcates about  $750\mu$  caudad of oral sucker, common cecum short. The gynaecophoric canal origi-

nates abruptly just posterior to acetabulum and extends to posterior tip of body. Testes numerous, disposed in two rows commencing about  $490\mu$  caudad of acetabulum and terminating about one-fourth of body length from posterior end.

*Female* unknown.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Hydrocoloeus melanocephalus*); secondary, unknown.

*Location*.—Heart.

*Distribution*.—Europe (Italy).

So far as may be determined from Parona and Ariola's (1896) description, there appears to be no essential difference, as Odhner (1912) points out, between *Ornithobilharzia kowalewskii* and *O. cancellulata*. The available descriptions are, however, so incomplete that a study of specimens of these species is necessary before final decision should be made.

#### ORNITHOBILHARZIA ODHNERI Faust, 1924

Figures 43-45

*Specific diagnosis*.—*Ornithobilharzia*:

*Male* 6 to 7 mm. long by  $220\mu$  to  $260\mu$  in cross section. Cuticle covered with spines. Oral sucker  $120\mu$  to  $155\mu$  in diameter; acetabulum  $160\mu$  to  $165\mu$  in diameter. The gynaecephoric canal is deep and broad. The esophagus branches immediately cephalad of the acetabulum; intestinal ceca sinuous, uniting caudally six-sevenths of body length from anterior end; common cecum short. Testes oval, about 65 in number, and lying in median line in equatorial three-sevenths of body. Seminal vesicle situated midway between anterior testis and acetabulum, and communicating directly with a rudimentary cirrus pouch which lies dorsad of the genital pore; ejaculatory duct rudimentary; prostate absent.

*Female* 3 mm. long by  $100\mu$  to  $120\mu$  in diameter in cross section. Cuticle covered with fine spines. Oral sucker and acetabulum equal in size and measuring  $70\mu$  in diameter. The esophagus bifurcates cephalad of acetabulum, and the intestinal ceca unite about four-fifths of body length from anterior end; common cecum short. Ovary elongate, loosely coiled, and situated in anterior third of body. The oviduct arises from the posterior pole of ovary, bending laterad and continuing anteriorly to the ootype; seminal receptacle well developed, situated behind the ovary, and connected with oviduct by a short duct. Laurer's canal arises from dorsal aspect of seminal receptacle and opens through a minute pore on dorsal side of body. The vitellaria consist of paired follicles extending from a short distance caudad of seminal receptacle to near posterior end of body. The vitelline duct

extends forward parallel with the oviduct and joins it at the ootype. Uterus short and containing a single egg. The genital pore occupies a median position immediately caudad of acetabulum.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (Asiatic curlew (*Numenius arquatus*)); secondary, unknown.

*Location*.—Portal vein.

*Distribution*.—Asia (China).

**ORNITHOBILHARZIA MACROBILHARZIA (Travassos, 1923), new combination**

*Synonym*.—*Macrobilharzia macrobilharzia* Travassos, 1923, pp. 18–19 (in *Plotus anhinga*; Brazil).

*Specific diagnosis*.—*Ornithobilharzia*:

*Male* 40 to 57 mm. long and 3.5 mm. wide when folded. Post-acetabular portion of body folded longitudinally but not permanently; preacetabular portion 4 mm. long and separated from posterior portion by a constriction. Oral sucker terminal, 740 $\mu$  in diameter; acetabulum salient, 1.3 mm. in diameter. Esophagus 1 mm. long; pharynx absent; intestinal ceca sinuous and uniting caudally near posterior end of body. Testes 230 to 250 in number, disposed in two rows in anterior half of body, and having an average diameter of 170 $\mu$  to 200 $\mu$ . Seminal vesicle present, pretesticular.

*Female* unknown.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Anhinga anhinga*=*Plotus anhinga*); secondary, unknown.

*Location*.—Portal vein.

*Distribution*.—South America (Brazil).

This species was described by Travassos (1923) as the type of a new genus, *Macrobilharzia*. On analysis, the characters given by Travassos do not appear to differ sufficiently from those of the genus *Ornithobilharzia* Odhner to justify the recognition of *Macrobilharzia* as a distinct genus. The body form, the disposition of the large number of small testes, and the position of the seminal vesicle are the same as for species of *Ornithobilharzia*. Its size, admittedly, is unusual for this genus, but size alone can not be regarded as a character of generic value.

**ORNITHOBILHARZIA TURKESTANICUM (Skrjabin, 1913), new combination**

Figures 46–50

*Synonyms*.—*Schistosoma turkestanicum* Skrjabin, 1913, pp. 458–468 (in *Bos taurus*; Russian Turkestan); *Schistosoma bomfordi* Montgomery of Marotel, 1908.

*Specific diagnosis*.—*Ornithobilharzia*:

*Male* 4.2 to 8 mm. long by  $340\mu$  to  $476\mu$  wide. Cuticle without tubercles. Oral sucker subterminal,  $255\mu$  long by  $154\mu$  wide; acetabulum  $289\mu$  by  $278\mu$ , and situated about  $425\mu$  caudad of the oral sucker. The esophagus shows two dilations and is surrounded by the esophageal glands; intestinal ceca unite caudally about 1.2 mm. from posterior end of body; in some specimens transverse commissures are present in posterior half of body which connect the two ceca. The testes, 70 to 80 in number, occupy a space about 3 mm. long in the median line. The genital pore lies immediately caudad of the acetabulum.

*Female* 3.4 to 5.5 mm. long by  $102\mu$  wide in region of ovary; body slender and almost circular in cross section. The suckers measure  $72\mu$  in diameter, and the acetabulum is situated about  $170\mu$  caudad of the oral sucker. Esophagus simple; intestinal ceca unite 1.632 mm. from posterior end of body. Ovary spiral,  $255\mu$  long, and situated anterior to cecal union. The vitellaria are composed of elongate follicles which occupy the space from the cecal union to the posterior end of body. Egg oval,  $72\mu$  to  $74\mu$  long by  $22\mu$  to  $26\mu$  wide, and provided with a spinelike prolongation at each pole.

*Cercariae* unknown or unrecognized.

*Hosts*.—Primary, mammals (*Bos taurus* and *Felis domestica*); secondary, unknown.

*Location*.—Branches of the portal vein.

*Distribution*.—Asia (Russian Turkestan) and Europe (France).

**ORNITHOBILHARZIA BOMFORDI (Montgomery, 1906), new combination**

Figures 51-52

*Synonyms*.—*Schistosoma bomfordi* Montgomery, 1906, pp. 143-147 (in *Bos indicus*; India).

*Specific diagnosis*.—*Ornithobilharzia*:

Male 7.089 mm. long; anterior portion of body  $357\mu$  wide; posterior portion  $408\mu$  wide in region of testes and  $170\mu$  in diameter at caudal extremity. The anterior portion of the body is flattened and the posterior portion inrolled, forming the gynaeophoric canal. Cuticle tuberculate and spiny; spines also present in suckers and in gynaeophoric canal. Oral sucker cup-shaped,  $306\mu$  in diameter; acetabulum pedunculated,  $340\mu$  in diameter, and situated  $850\mu$  caudad of oral sucker. Testes 61 in number, oval in shape, and measuring  $100\mu$  by  $90\mu$ , the total length of the chain of testes being 3.06 mm., or about three-sevenths of total body length. The seminal vesicle is situated in front of the testes, about  $200\mu$  caudad of the union of the anterior and posterior portions of the body.

*Female* 7.31 mm. long by  $172\mu$  wide at the ovary. Cuticle devoid of spines, except in suckers and at posterior end of body. Oral

sucker subterminal,  $46\mu$  in diameter; acetabulum slightly salient,  $42\mu$  in diameter. Esophagus simple,  $204\mu$  long; intestinal ceca unite posteriorly 1.819 mm. from the esophageal bifurcation; common cecum 5.109 mm. long and terminating  $178\mu$  from posterior extremity. Ovary oval in outline,  $300\mu$  long, and situated in front of cecal union. Uterus 1.4 mm. long; genital pore slightly salient and situated immediately caudad of acetabulum. The vitellaria lie on each side of the common cecum and extend from the cecal union to the posterior end of body. Egg oval and provided with a terminal spine; immature egg  $100\mu$  to  $115\mu$  long by  $44\mu$  to  $48\mu$  wide, spine  $8\mu$  to  $10\mu$  long; mature egg, containing a miracidium,  $125\mu$  to  $136\mu$  long by  $53\mu$  to  $60\mu$  wide, spine  $6\mu$  to  $8\mu$  long.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, mammal (*Bos (Bubalus) bubalis*=*Bos indicus*); secondary, unknown.

*Location*.—Mesenteric veins.

*Distribution*.—Asia (India).

*Schistosoma bomfordi* Montgomery and *S. turkestanicum* Skrjabin are transferred to the genus *Ornithobilharzia* on the basis of morphological similarity to other species of the genus. The number and position of the testes in the male, and the shape and position of the ovary in the female are so similar to those in *Ornithobilharzia intermedia* Odhner, type of *Ornithobilharzia*, that they are obviously congeneric. The fact that both *O. bomfordi* and *O. turkestanicum* are at present known only from mammalian hosts does not appeal to the writer as being a matter of sufficient importance to justify their retention in the genus *Schistosoma*. In view of the morphological relationship of *O. bomfordi* and *O. turkestanicum* to species occurring in birds, it may be assumed that these parasites, which are of rare occurrence in their mammalian hosts, may be only accidental and facultative parasites of these hosts, and it may be surmised that they are normal parasites in birds of some sort.

The report of the occurrence of *O. bomfordi* as a parasite of cattle in France, by Marotel (1908), is apparently erroneous, as the species which he described has an egg with two spines, one at each end, which measures  $80\mu$  to  $100\mu$  long by  $30\mu$  to  $35\mu$  wide. Since *O. turkestanicum* is the only schistosome reported from cattle as having a large number of testes, and an egg of the type described, it appears that this was the species found by Marotel. Velu and Barotte (1924; p. 328) are apparently of this opinion as they give France as a locality for *O. turkestanicum* and their description of the egg of this species is essentially the same as that given by Marotel for *O. bomfordi*.

## MICROBILHARZIA, new genus

*Generic diagnosis.*—Schistosominae: Male longer than female. Gynaecophoric canal well developed, commencing in front of the acetabulum. Suckers present in both sexes. Digestive tract similar to that of *Schistosoma*. Testes 18 to 20 in number, arranged in two irregular rows in anterior half of body. Genital pore situated about midway between acetabulum and the anterior testis. Female slender, almost cylindrical anteriorly, flattened posteriorly. Ovary loosely spiral, slightly pre-equatorial in position. Uterus long and containing a single egg. Vitellaria occupy about one-half of body length. Larva unknown or unrecognized.

*Type species.*—*Microbilharzia chapini*, new species.

## MICROBILHARZIA CHAPINI, new species

Figures 37-38

*Synonym.*—*Ornithobilharzia* species Chapin, 1924, p. 208.

*Specific diagnosis.*—*Microbilharzia*:

*Male* 3.27 to 4.25 mm. long by 626 $\mu$  wide. Anterior part of body short, subcylindrical; posterior part long and with the lateral edges infolded, forming a deep gynaecophoric canal which originates anteriorly a short distance in front of acetabulum and extends to posterior end of body. Cuticle lacking (apparently due to maceration) in all specimens available for study. Oral sucker subterminal, 152 $\mu$  in diameter; acetabulum pedunculated, 175 $\mu$  in diameter, situated 437 $\mu$  caudad of oral sucker. Esophagus simple, bifurcating in front of the acetabulum as in other schistosomes; intestinal ceca sinuous and uniting posteriorly about 390 $\mu$  from posterior end of body. Testes 18 to 20 in number, arranged in two irregular rows originating anteriorly about 540 $\mu$  to 550 $\mu$  caudad of acetabulum and extending slightly posterior to equator of body. Seminal vesicle small and situated about midway between acetabulum and anterior testis.

*Female* 3.7 mm. long by 100 $\mu$  wide. Cuticle smooth. Oral sucker poorly developed, 30 $\mu$  in diameter. Ovary slender, loosely spiral, 390 $\mu$  long when measured in a straight line and disregarding total length of spiral, and slightly pre-equatorial in position. The vitellaria consist of transversely elongated follicles, and extend from the distal pole of the ovary to the posterior end of body. Uterus long and apparently containing but one egg.

*Cercaria* unknown or unrecognized.

*Hosts.*—Primary, birds (*Marila affinis*); secondary, unknown.

*Location.*—Mesenteric veins.

*Distribution.*—North America (United States; Shadyside, Md.).

*Type specimens.*—United States National Museum Helminthological Collections No. 25169; paratype No. 27888; collected by Dr. E. A. Chapin, January 20, 1923.

This trematode appears to have closer affinities with species of *Austrobilharzia* than with those of any other genus. There are some characters in this species which differ from *A. terrigalensis*, type of *Austrobilharzia*, to such an extent that the writer hesitates to place his species in this genus; a new genus, *Microbilharzia*, is therefore proposed for it. In proposing this genus the writer realizes that the characters given in the diagnosis may be of specific rather than of generic value, but in order to include this species in *Austrobilharzia*, or in any of the other genera, it would be necessary to emend the generic diagnosis more or less extensively; this is regarded as inadvisable until more material is available for study.

### BILHARZIELLINAE, new subfamily

*Subfamily diagnosis.*—Schistosomidae: Male and female similar in form, either flattened or threadlike. Suckers present or absent. Gynaecophoric canal absent or imperfectly formed. Paired intestinal ceca short; common cecum long, with or without lateral dendritic branches. Testes numerous and situated along the course of the common cecum. Uterus short and containing a single egg.

*Type genus.*—*Bilharziella* Looss, 1899.

#### KEY TO THE GENERA OF BILHARZIELLINAE

- |  |                                   |
|--|-----------------------------------|
| 1. Body cylindrical or nearly so.....  | 2.                                |
| Body flattened.....  | 3.                                |
| 2. Female unknown; posterior end of body threadlike, middle portion wider than either the anterior or posterior portions; no gynaecophoric canal; suckers present..... | <b>Trichobilharzia</b> , p. 29.   |
| Male and female very long and slender; gynaecophoric canal reduced to a short groove in the anterior part of the body; suckers absent.                                 | <b>Gigantobilharzia</b> , p. 30.  |
| 3. Suckers present; common cecum without lateral dendritic branches.   | <b>Bilharziella</b> , p. 25.      |
| Suckers absent; common cecum with short, lateral dendritic branches.   | <b>Dendritobilharzia</b> , p. 28. |

### Genus BILHARZIELLA Looss, 1899

*Generic diagnosis.*—Bilharziellinae: Both sexes with the posterior part of the body distinctly flattened. Female shorter than male. Intestinal ceca united posteriorly at or near equator of body; common cecum long, without lateral branches, and extending in a zigzag manner to posterior end of body. Male genital opening situated on left side of body a considerable distance caudad of acetabulum. Cirrus pouch present, containing the prostate and the ejaculatory duct.

Seminal vesicle long and free in the parenchyma. Testes, about 110 in number, in posterior part of body on each side of the common cecum. Female genital opening immediately posterior to acetabulum. Uterus short and containing a single egg. Vitellaria situated on each side of the common cecum. Egg elongated anteriorly, enlarged and provided with a small spine posteriorly.

*Type species.*—*Bilharziella polonica* (Kowalewski, 1895) Looss, 1899.

KEY TO SPECIES OF BILHARZIELLA

Male 4 mm. long by  $530\mu$  wide; testes 110 in number; female 2 mm. long; egg  $385\mu$  to  $400\mu$  long by  $100\mu$  wide, elongated anteriorly and widened posteriorly.

**B. polonica**, p. 26.

Male 2.3 mm. long by  $96\mu$  wide; testes 50 to 70 in number; female 3.4 to 4 mm. long by  $65\mu$  wide; egg spindle-shaped,  $226\mu$  long by  $62\mu$  wide.

**B. yokogawai**, p. 27.

BILHARZIELLA POLONICA (Kowalewski, 1895) Looss, 1899

Figures 56-58

*Synonyms.*—*Bilharzia polonica* Kowalewski, 1895, pp. (1-27) 41-70 (in *Anas boschas fera* and *A. crecca*; Poland); *Schistosomum polonicum* (Kowalewski, 1895) Railliet, 1898, p. 412; *Ornithobilharzia polonica* (Kowalewski, 1895) Tanabe, 1925, p. 258.

*Specific diagnosis.*—*Bilharziella*:

*Male* 4 mm. long by  $530\mu$  wide. Body flattened, lanceolate. Oral sucker  $102\mu$  in diameter; acetabulum  $136\mu$  in diameter and situated about  $760\mu$  caudad of oral sucker. Esophagus simple, bifurcating in front of acetabulum; intestinal ceca unite posteriorly a short distance anterior to equator of body; common cecum long, extending caudally in a zigzag manner and terminating near posterior end of body. Testes numerous, about 110 in number, situated on both sides of the common cecum. Cirrus pouch present, containing the ejaculatory duct and a well-developed prostate. Seminal vesicle long and only partially enclosed by the cirrus pouch. Genital pore on left side of body,  $800\mu$  caudad of acetabulum.

*Female* about 2 mm. long and  $250\mu$  wide. Body form similar to that of male. Oral sucker  $51\mu$  in diameter; acetabulum  $68\mu$  in diameter and situated  $370\mu$  caudad of oral sucker. Digestive tract similar to that of male. Ovary weakly spiral and situated in front of cecal union. Uterus short and containing a single egg. Genital pore situated immediately caudad of acetabulum. Vitellaria composed of numerous follicles lying on each side of the common cecum. Egg  $385\mu$  to  $400\mu$  long by  $100\mu$  wide, elongated anteriorly and widened posteriorly, and provided with a small hooklike spine.

*Cercaria* unknown or unrecognized.



*Hosts*.—Primary, birds (*Anas platyrhynchos* (= *A. boschas fera*), *A. platyrhynchos domestica*, *Querquedula querquedula* (= *Anas querquedula*), *Nettion crecca* (= *Anas crecca*) *Dafila acuta* (= *Anas acuta*), *Fuligula fuligula* (= *Nyroca fuligula*, = *Fuligula cristata*), *Ardea cinerea*, *Nyroca leucophthalma* (= *Fuligula leucophthalma*) and *Cygnus olor*); secondary, unknown.

*Location*.—Abdominal blood vessels.

*Distribution*.—Europe (Poland and Russia) and North America (United States National Zoological Park, Washington, D. C.).

This species is represented in the Helminthological Collection of the United States National Museum by a single male specimen, No. 17432, collected October 8, 1907, by Dr. M. C. Hall, from a swan, *Cygnus olor*, which died in the National Zoological Park. This specimen is 3.4 mm. long by 300 $\mu$  wide. The oral sucker is 130 $\mu$  in diameter; the acetabulum is pedunculated, 182 $\mu$  in diameter, and situated 600 $\mu$  caudad of oral sucker. Such other characters as can be ascertained correspond so closely to those of *B. polonica* that there appears to be no doubt as to its specific identity.

#### BILHARZIELLA YOKOGAWAI Oiso, 1927

Figures 61-64

*Specific diagnosis*.—*Bilharziella*:

*Male* flat, 2.3 mm. long by 96 $\mu$  wide; sides of body parallel, posterior extremity truncate. Gynaecophoric canal short, extending from immediately caudad of acetabulum to level of cecal union (according to Oiso's figure). Oral sucker subterminal; acetabulum situated about 300 $\mu$  caudad of oral sucker. Esophagus about 250 $\mu$  long; intestinal caeca unite about 500 $\mu$  from anterior end of body; common cecum sinuous and terminating about 75 $\mu$  from posterior extremity of body. Testes oval, 50 to 70 in number, situated on each side of the common cecum; seminal vesicle large and irregular in outline, and situated between the cecal branches.

*Female* very slender, 3.4 to 4 mm. long by 65 $\mu$  wide. Egg spindle-shaped, 226 $\mu$  long by 62 $\mu$  wide, and containing a well-developed miracidium.

*Cerceria* furcocercous, pharyngeal (?), spinose. Body cylindrical in shape, 262 $\mu$  long by 64 $\mu$  wide; tail stem 363 $\mu$  long by 39 $\mu$  wide; furcal rami 258 $\mu$  long by 19 $\mu$  wide. Eyespots present, situated about 100 $\mu$  from anterior end of body. Acetabulum comparatively large and well developed, and situated 235 $\mu$  from anterior end of body. Pharynx present (?). Penetration glands consist of three pairs of large cells, the ducts of which open at anterior edge of oral sucker and are capped by an equal number of piercing spines. Germ cells lie in median line caudad of acetabulum. Excretory system pattern consists of seven pairs of flame cells in body and one pair in tail stem.

*Hosts*.—Primary, birds (duck, presumably *Anas platyrhynchos domestica*) secondary, snail (*Lymnaea radiix*).

*Location*.—Portal and intestinal veins.

*Distribution*.—Formosa.

Genus **DENDRITOBILHARZIA** Skrjabin and Zakharow, 1920

*Generic diagnosis*.—Bilharziellinae: Body of both sexes elongated. Cuticle without spines or tubercles. Suckers absent. Digestive system similar to that in *Bilharziella*; common cecum long, zigzag, and provided with short, club-shaped or branched, lateral ceca. Genital pore of male in anterior part of body and to the left of median line. Testes numerous, situated on each side of the common cecum and extending from the cecal union to the posterior end of body. Ovary spiral and situated between the cecal branches. Vitelline follicles numerous, situated along the course of the common cecum.

*Type species*.—*Dendritobilharzia pulverulenta* (Braun, 1901) Skrjabin, 1924.

This genus has many characters in common with *Bilharziella*, but the writer regards the absence of suckers and the branched condition of the common cecum as characters warranting the recognition of *Dendritobilharzia* as a valid genus. Since *Dendritobilharzia odhneri* Skrjabin and Zakharow, 1920, was later recognized by Skrjabin (1924) as identical with *Bilharziella pulverulenta* Braun, the name of the type species becomes *D. pulverulenta* (Braun, 1901) Skrjabin, 1924.

KEY TO THE SPECIES OF DENDRITOBILHARZIA

Male 8 to 8.3 mm. long by 1 to 1.5 mm. wide; female 1.57 mm. long by 0.29 mm. wide; in *Querquedula querquedula* and *Anas platyrhynchos*.

**D. pulverulenta**, p. 28.

Male unknown. Female 14.2 mm. long by 1.41 mm. wide; in *Pelecanus onocrotalus*.

**D. loossi**, p. 29.

**DENDRITOBILHARZIA PULVBRULENTA** (Braun, 1901) Skrjabin, 1924

Figures 53-54

*Synonyms*.—*Bilharziella pulverulenta* Braun, 1901, pp. 946-947 (in *Anas querquedula*; Africa); *Dendritobilharzia odhneri* Skrjabin and Zakharow, 1920, pp. 2-4, 6.

*Specific diagnosis*.—*Dendritobilharzia*.

*Male* 8 to 8.3 mm. long by 1 to 1.5 mm. wide. Cuticle without spines or tubercles. Suckers absent. Esophagus 690 $\mu$  long; intestinal ceca united posteriorly about 920 $\mu$  from the esophageal bifurcation; common cecum long and zigzag, and provided with short

club-shaped, sometimes branched, lateral ceca. Testes about 110 in number, situated along the common cecum for its entire length. Seminal vesicle long, spiral, and situated in the anterior sixth of body. The genital pore is located on the left side about 1.35 mm. from anterior end of body.

*Female* (according to Semenov (1927) 1.5657 mm. long by 0.2875 mm. wide. Body divided into two parts by an irregular transverse groove, the anterior portion being 0.4228 mm. long and the posterior portion 1.1427 mm. long. Suckers absent. Oral aperture terminal. Esophagus slightly wavy; common cecum zigzag and extending to posterior end of body. Ovary 0.1028 mm. long by 0.0914 mm. wide, situated immediately caudad of the transverse groove and to one side of median line. Vitelline follicles numerous and distributed throughout posterior part of body.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Querquedula querquedula* (= *Anas querquedula*) and *Anas platyrhynchos* (= *A. boschas*)); secondary, unknown.

*Location*.—Blood vessels.

*Distribution*.—Africa (Dongola, Sudan), and Europe (Russia).

#### DENDRITOBILHARZIA LOOSI Skrjabin, 1924

*Specific diagnosis*.—*Dendritobilharzia*.

*Male* unknown.

*Female* 14.2 mm. long by 1.41 mm. wide. Oral sucker and acetabulum absent. Esophagus 450 $\mu$  long; intestinal ceca united posteriorly about 3.47 mm. from the esophageal bifurcation; common cecum as in *D. pulverulenta*. Genital organs, consisting of a spiral, tubular ovary, and an unpaired vitelline duct, lie in the space between the intestinal ceca. The vitellaria consist of follicles situated along the course of the common cecum.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Pelecanus onocrotalus*); secondary, unknown.

*Location*.—Blood vessels.

*Distribution*.—Europe (Russia).

This description is taken from that of Skrjabin (1924). Unfortunately very little detail is given as the description was based upon a single female specimen. In discussing this species, Skrjabin regards it as unlikely that this form could be identical with *D. pulverulenta* because of the great difference in size.

#### Genus TRICHOBILHARIA Skrjabin and Zakharow, 1920

*Generic diagnosis*.—Bilharziellinae; body slender and divided into two portions; the anterior wider portion separated from the posterior

threadlike portion by a slight dilation. Oral sucker smaller than acetabulum. Gynaecophoric canal absent. Cirrus pouch and seminal vesicle present. Testes numerous and situated in posterior portion of body. Female unknown.

*Type species.*—*Trichobilharzia kossarewi* Skrjabin and Zakharow, 1920.

**TRICHOBILHARZIA KOSSAREWI** Skrjabin and Zakharow, 1920

Figure 55

*Specific diagnosis.*—*Trichobilharzia*.

*Male* 4 mm. long; anterior portion of body  $60\mu$  wide, posterior portion  $20\mu$  wide; between the anterior and posterior portions the body is dilated to  $150\mu$  in width and this part is covered with fine spines. Oral sucker  $30\mu$  in diameter; acetabulum  $50\mu$  in diameter, spiny, and situated  $690\mu$  caudad of oral sucker. Testes numerous,  $50\mu$  long by  $18\mu$  wide, and situated in the posterior, threadlike portion of body. Cirrus pouch  $200\mu$  long. Seminal vesicle  $220\mu$  long. Genital pore 1.26 mm. from anterior end of body.

*Female* unknown.

*Cercaria* unknown or unrecognized.

*Hosts.*—Primary, birds (*Querquedula querquedula* (= *Anas circa*)); secondary, unknown.

*Location.*—Blood vessels.

*Distribution.*—Europe (Russia).

**Genus GIGANTOBILHARZIA** Odhner, 1910

*Generic diagnosis.*—Bilharziellinae: Female cylindrical and shorter than the somewhat flattened male. Posterior extremity of both sexes provided with lateral lobelike projections. Cuticle without spines or tubercles. Suckers absent. Gynaecophoric canal reduced to a short groove, situated in anterior part of body. Digestive system similar to that of *Bilharziella*. Testes originate caudad of gynaecophoric canal and extend to posterior end of body. Cirrus pouch absent. Genital pore situated at anterior end of gynaecophoric canal and slightly to the left of the median line. Ovary moderately long and spiral. Vitelline follicles occupy about nine-tenths of body length. Uterus short and containing a single egg.

*Type species.*—*Gigantobilharzia acotylea* Odhner, 1910.

**GIGANTOBILHARZIA ACOTYLEA** Odhner, 1910

Figures 59–60

*Specific diagnosis.*—*Gigantobilharzia*.

*Male* 140 to 165 mm. long by  $250\mu$  to  $350\mu$  wide in expanded specimens; when preserved, the length is about one-half that of expanded

specimens, the width being  $450\mu$  to  $650\mu$  and the thickness about three-fourths of the width. Anterior end of body either pointed or blunt, depending upon the amount of contraction during fixation; posterior end provided with peculiar lobelike projections which give it the appearance of being obliquely truncate. Suckers absent. The gynae-cophoric canal is reduced to a groove-like depression,  $550\mu$  to  $750\mu$  long by  $100\mu$  wide in flattened specimens, and situated  $500\mu$  from anterior end of body. Oral opening terminal; esophagus  $180\mu$  long; intestinal ceca short and united posteriorly at anterior end of gynae-cophoric canal; common cecum long and terminating near posterior end of body. Testes consist of numerous follicles situated along the course of the common cecum. Terminal portion of genital system (Endapparat) consists of a cirrus pouch containing the ejaculatory duct, prostate, and a portion of the seminal vesicle, and is situated between the branches of the intestinal ceca. The genital pore is situated on a small papilla at the anterior end of the gynae-cophoric canal and slightly to the left of the median line.

*Female* 30 to 35 mm. long, slender, circular on cross section, and  $100\mu$  to  $120\mu$  in diameter. Anterior end of body attenuated; the posterior end is similar to that of the male. Esophagus  $700\mu$  to  $900\mu$  long; intestinal ceca unite posteriorly about 2 to 3 mm. from anterior end of body; common cecum slender and extending to posterior extremity of body. Ovary tubelike and spiral, situated anterior to the cecal union. The oviduct arises from the posterior pole of the ovary and passes to a large seminal receptacle, and then extends forward ventrally to the ovary and unites with the vitelline duct a short distance in front of the ovary. Vitellaria unpaired, composed of rounded follicles extending from the cecal union to the posterior end of body. Uterus short and containing but one egg. Genital pore median, about  $60\mu$  from the anterior extremity. Egg oval, about  $100\mu$  long.

*Cercaria* unknown or unrecognized.

*Hosts*.—Primary, birds (*Larus fuscus*, *Hydrocoloeus melanocephalus* and *H. ridibundus*); secondary, unknown.

*Location*.—Intestinal veins.

*Distribution*.—Europe (Sweden and England).

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## EXPLANATION OF PLATES

## ABBREVIATIONS

|                                 |                                      |
|---------------------------------|--------------------------------------|
| <i>ac.</i> Acetabulum.          | <i>os.</i> Oral sucker.              |
| <i>c.</i> Common cecum.         | <i>ov.</i> Ovary.                    |
| <i>cb.</i> Cecal branches.      | <i>ovd.</i> Oviduct.                 |
| <i>cp.</i> Cirrus pouch.        | <i>pg.</i> Penetration glands.       |
| <i>e.</i> Egg.                  | <i>pgd.</i> Penetration gland ducts. |
| <i>cs.</i> Eye spot.            | <i>ph.</i> Pharynx.                  |
| <i>exb.</i> Excretory bladder.  | <i>ps.</i> Penetration spines.       |
| <i>exp.</i> Excretory pore.     | <i>shg.</i> Shell gland.             |
| <i>fc.</i> Flame cell.          | <i>sr.</i> Seminal receptacle.       |
| <i>gc.</i> Gynaecophoric canal. | <i>sv.</i> Seminal vesicle.          |
| <i>gp.</i> Genital pore.        | <i>t.</i> Testes.                    |
| <i>grmc.</i> Germ cells.        | <i>ut.</i> Uterus.                   |
| <i>hg.</i> Head gland.          | <i>vas.</i> Vas deferens.            |
| <i>lc.</i> Laurer's canal.      | <i>vd.</i> Vitelline duct.           |
| <i>n.</i> Nervous system.       | <i>vil.</i> Vitellaria.              |
| <i>ocs.</i> Esophagus.          | <i>vr.</i> Vitelline reservoir.      |
| <i>ocsg.</i> Esophageal glands. |                                      |

## PLATE 1

*Schistosoma haematobium*

- FIGURE 1. Anterior end of male. Original.  
 2. Male and female. After Manson-Bahr and Fairley, 1920.  
 3. Egg; greatly enlarged. After Looss, 1896.  
 4a. Cercaria. After Bettencourt and Borges, 1922.  
 4b. Cercaria showing excretory system. After Bettencourt and Borges, 1922.

*Schistosoma incognitum*

5. Egg. After Chandler, 1926.

## PLATE 2

*Schistosoma mansoni*

- FIGURE 6. Anterior end of male; lateral view. Original.  
 7. Anterior end of male; ventral view. Original.  
 8. Male. After Manson-Bahr and Fairley, 1920.  
 9. Female. After Manson-Bahr and Fairley, 1920.  
 10. Cercaria. After Faust, 1920.  
 11. Egg. After Cort, 1919.

## PLATE 3

*Schistosoma japonicum*

- FIGURE 12. Male. Original.  
 13. Female. Original.  
 14. Cercaria. After Cort, 1919.  
 15. Cercaria showing excretory system. After Cort, 1919.  
 16. Egg. After Cort, 1919.

## PLATE 4

*Schistosoma spindalis*

- FIGURE 17. Male with female in the gynaecophoric canal. After Vryburg, 1907.  
 18. Anterior end of male. After Vryburg, 1907.  
 19. Female. After Vryburg, 1907.  
 20. Cercaria. After Soparkar, 1921.  
 21. Cercaria showing excretory system. After Soparkar, 1921.  
 22. Egg. After Montgomery, 1906.

## PLATE 5

*Schistosoma bovis*

- FIGURE 23. (a) Male, (b) female, (c) egg. After Khalil, 1924.  
 24. Male and female. After Leuckart, 1894.  
 25. Eggs. After Sonsino, 1876.

## PLATE 6

*Schistosoma indicum*

- FIGURE 26. Male; from sheep. Original.  
 27. Female; from sheep. Original.  
 28. Female genital system. Original.  
 29. Egg. After Montgomery, 1906.

## PLATE 7

*Schistosomatium pathlopticum*

- FIGURE 30. Male and female. After Tanabe, 1923.  
 31. Cercaria. After Tanabe, 1923.  
 32. Egg. After Tanabe, 1923.

## PLATE 8

*Heterobilharzia americana*

- FIGURE 33. Male. Original.  
 34. Male; somewhat flattened. Original.

*Paraschistosomatium auhingae*

35. Female. Original.

## PLATE 9

*Austrobilharzia terrigalensis*

36. Male and female. After Johnston, 1917.

*Microbilharzia chapini*

37. Male and female. Original.  
 38. Male; ventral view. Original.

## PLATE 10

*Ornithobilharzia intermedia*

39. Male and female. After Odhner.

*Ornithobilharzia canaliculata*

40. Male and female. After Braun, 1902.

*Ornithobilharzia kowalcwskii*

41. Male. After Parona and Ariola, 1896.  
 42. Posterior end of male. After Parona, 1899.

## PLATE 11

*Ornithobilharzia odhneri*

- FIGURE 43. Male. After Faust, 1924.  
 44. Female. After Faust, 1924.  
 45. Female genital system. After Faust, 1924.

## PLATE 12

*Ornithobilharzia turkestanicum*

- FIGURE 46. Male and female. After Skrjabin, 1913.  
 47. Female; showing digestive system. After Skrjabin, 1913.  
 48. Posterior end of male. After Skrjabin, 1913.  
 49. Female genital system. After Skrjabin, 1913.  
 50. Eggs. After Skrjabin, 1913.

## PLATE 13

*Ornithobilharzia bomfordi*

- FIGURE 51. Male and female. After Montgomery, 1906.  
 52. Egg. After Montgomery, 1906.

*Dendritobilharzia pulverulenta*

53. Male. After Braun, 1902.  
 54. Male. After Skrjabin and Zakharow, 1920.

*Trichobilharzia kossarewi*

55. Male. After Skrjabin and Zakharow, 1920.

## PLATE 14

*Bilharziella polonica*

- FIGURE 56. Male. After Kowalewski, 1895.  
 57. Female. After Kowalewski, 1895.  
 58. Egg. After Kowalewski, 1895.

*Gigantobilharzia acotylica*

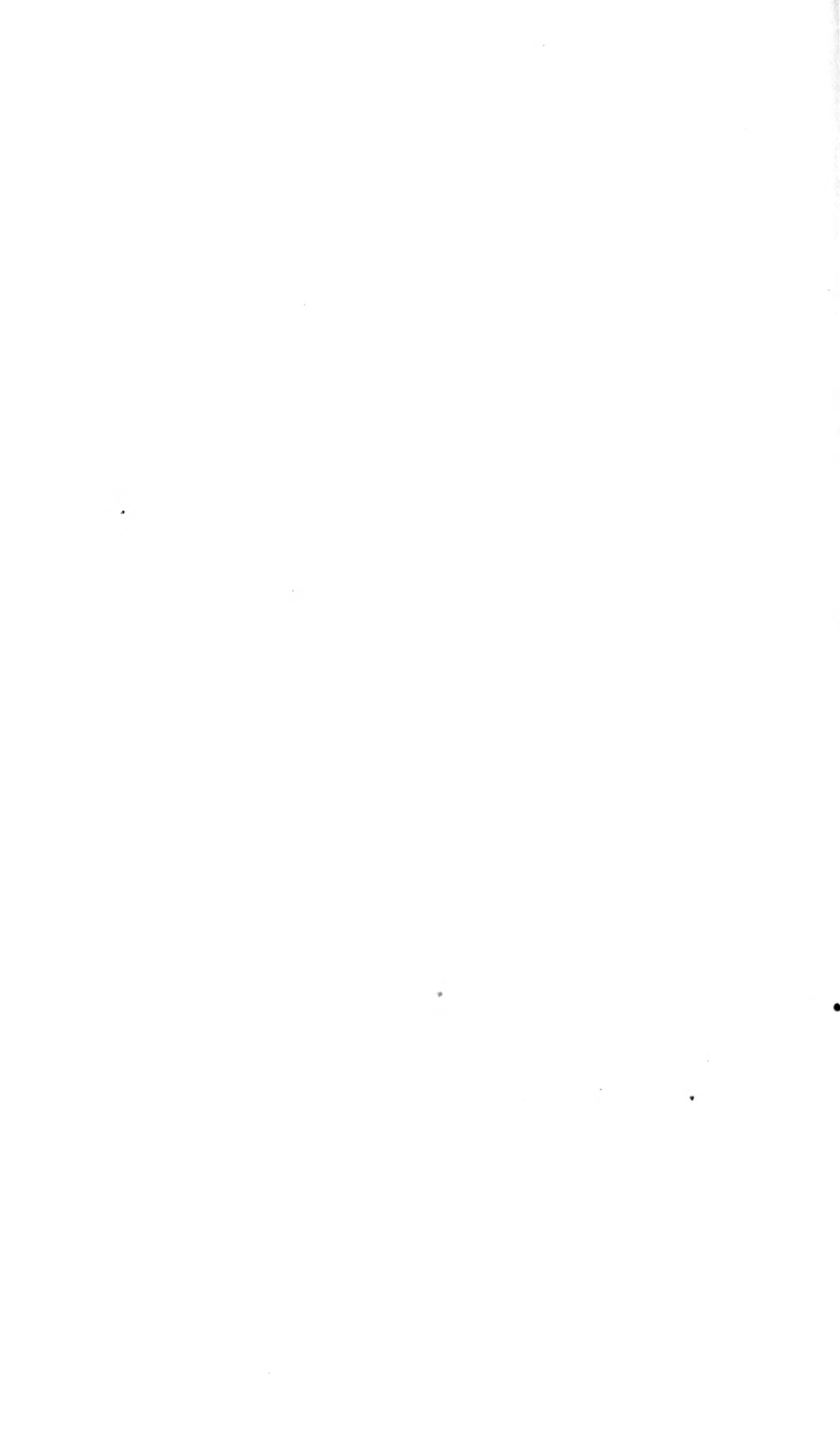
59. Male; (a) anterior end showing gynaecophoric canal, (b) posterior end, (c) anterior end showing digestive and reproductive systems. After Odhner, 1910.  
 60. Female; (a) anterior end, (b) female reproductive organs. After Odhner, 1910.

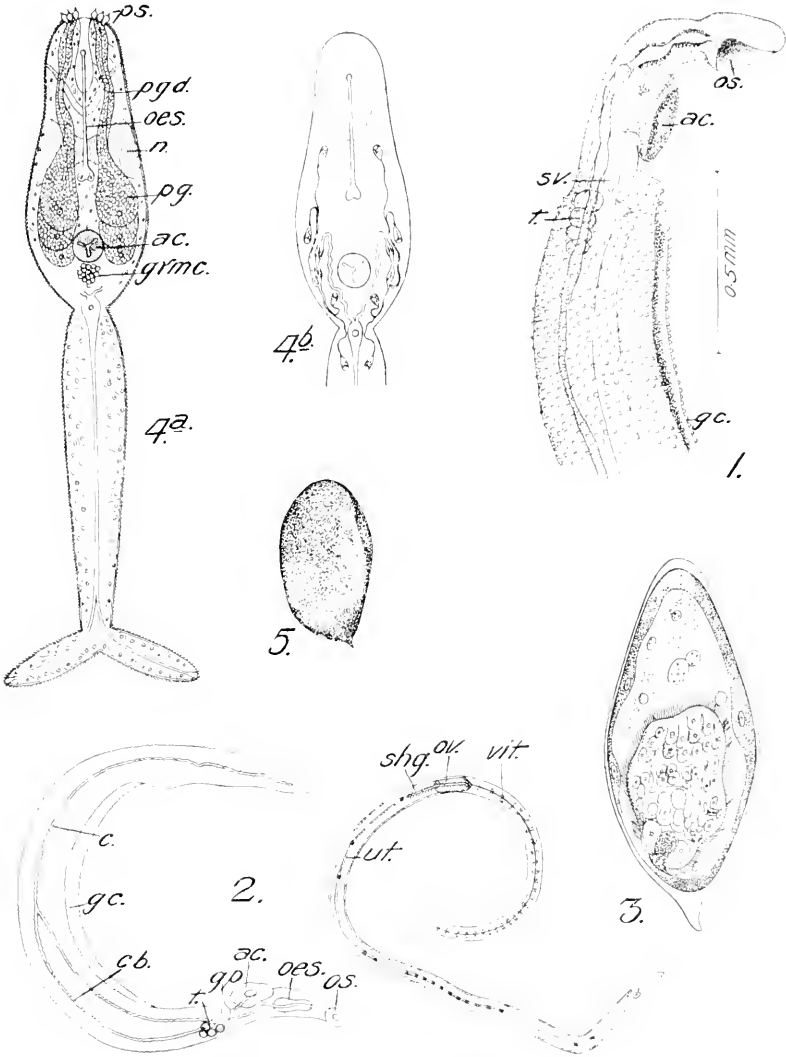
## PLATE 15

*Bilharziella yokogawai*

- FIGURE 61. Male; ventral view. After Oiso, 1927.  
 62. Male; anterior end showing gynaecophoric canal. After Oiso, 1927.  
 63. Egg. After Oiso, 1927.  
 64. Cercaria. After Oiso, 1927.

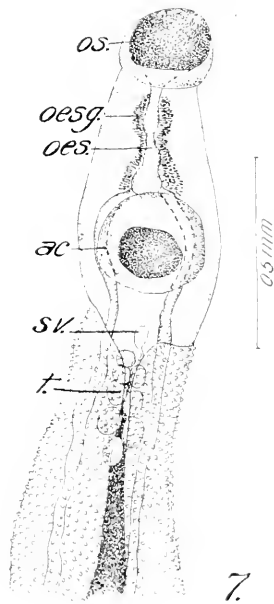
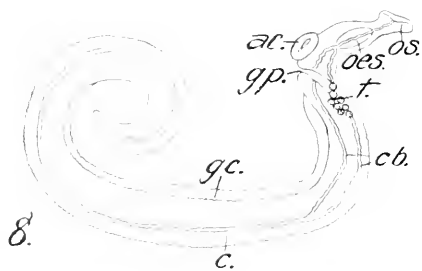
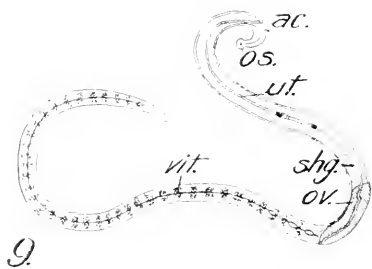
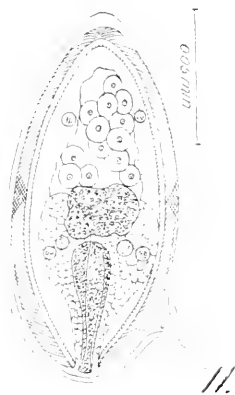
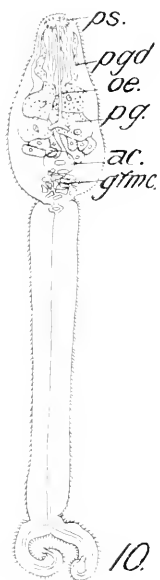
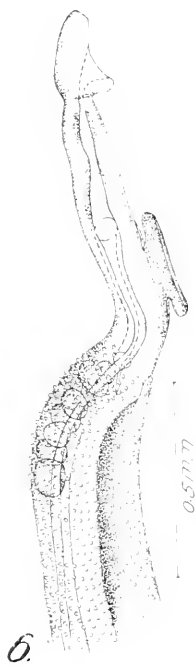






SCHISTOSOMA HAEMATOBIMUM AND S. INCOGNITUM

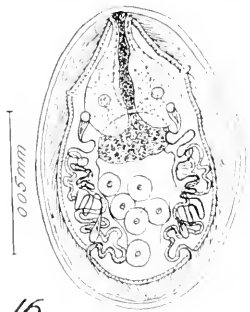
FOR EXPLANATION OF PLATE SEE PAGE 37



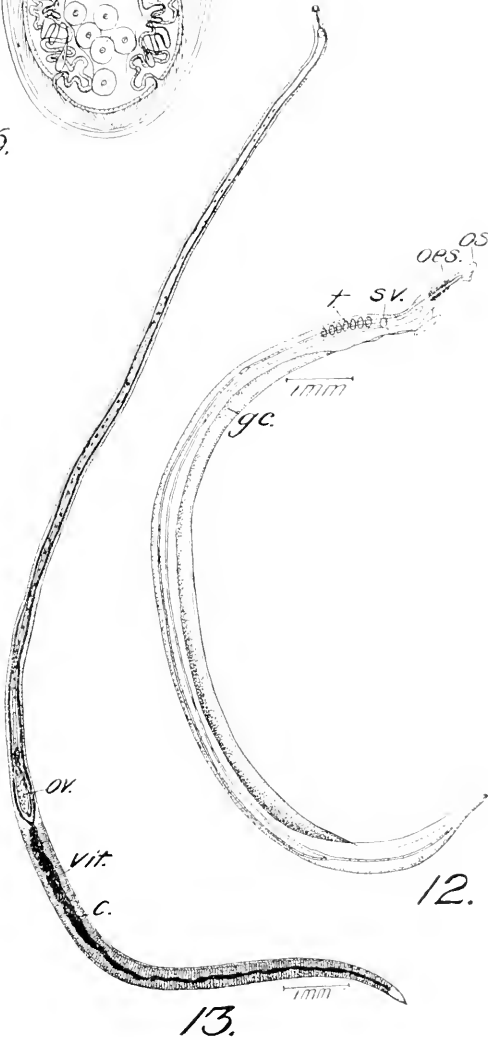
SCHISTOSOMA MANSONI

FOR EXPLANATION OF PLATE SEE PAGE 37

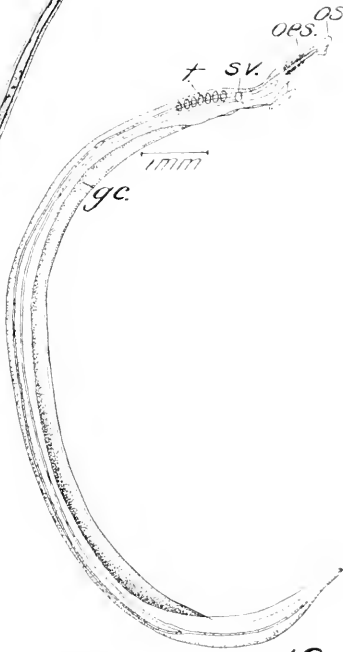




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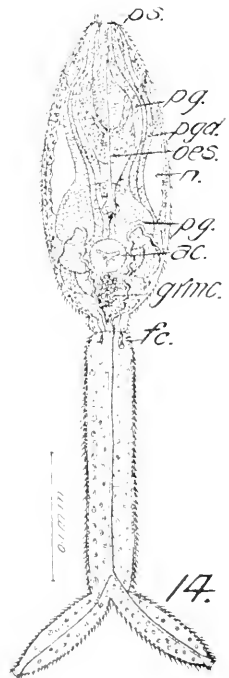
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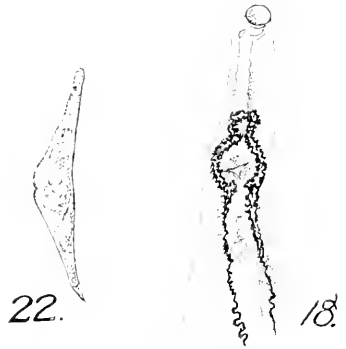
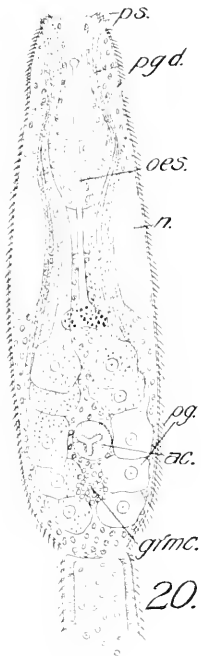
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14.

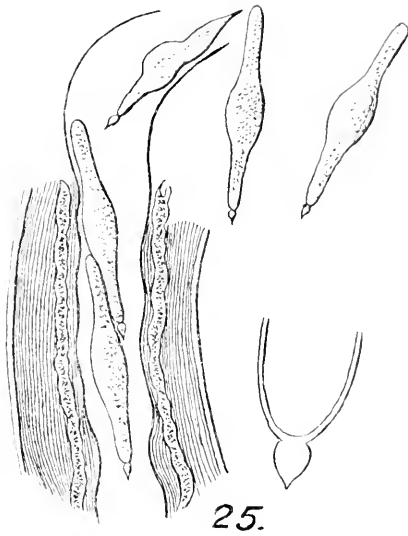
SCHISTOSOMA JAPONICUM

FOR EXPLANATION OF PLATE SEE PAGE 7



SCHISTOSOMA SPINDALIS

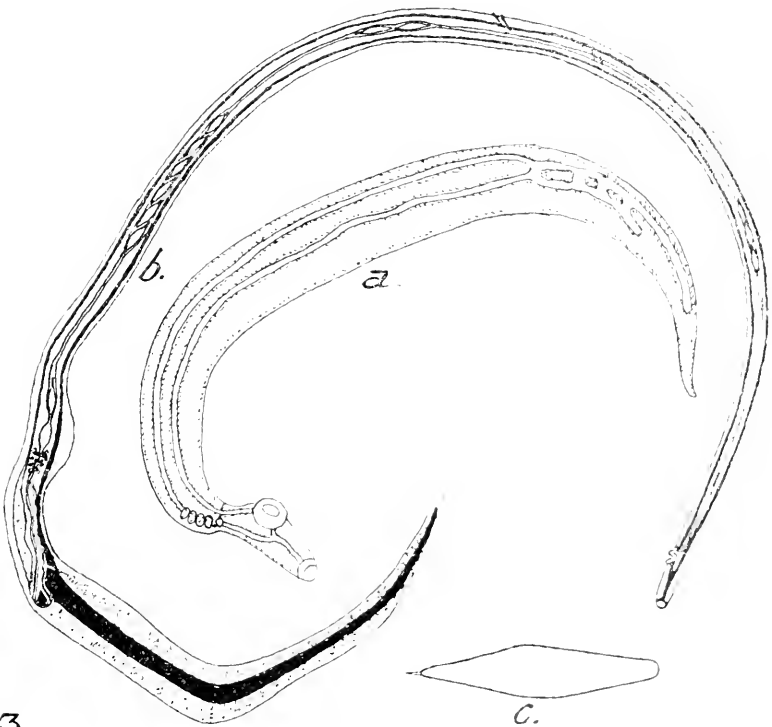
EXPLANATION OF PLATE 4: PAGE 37



25.



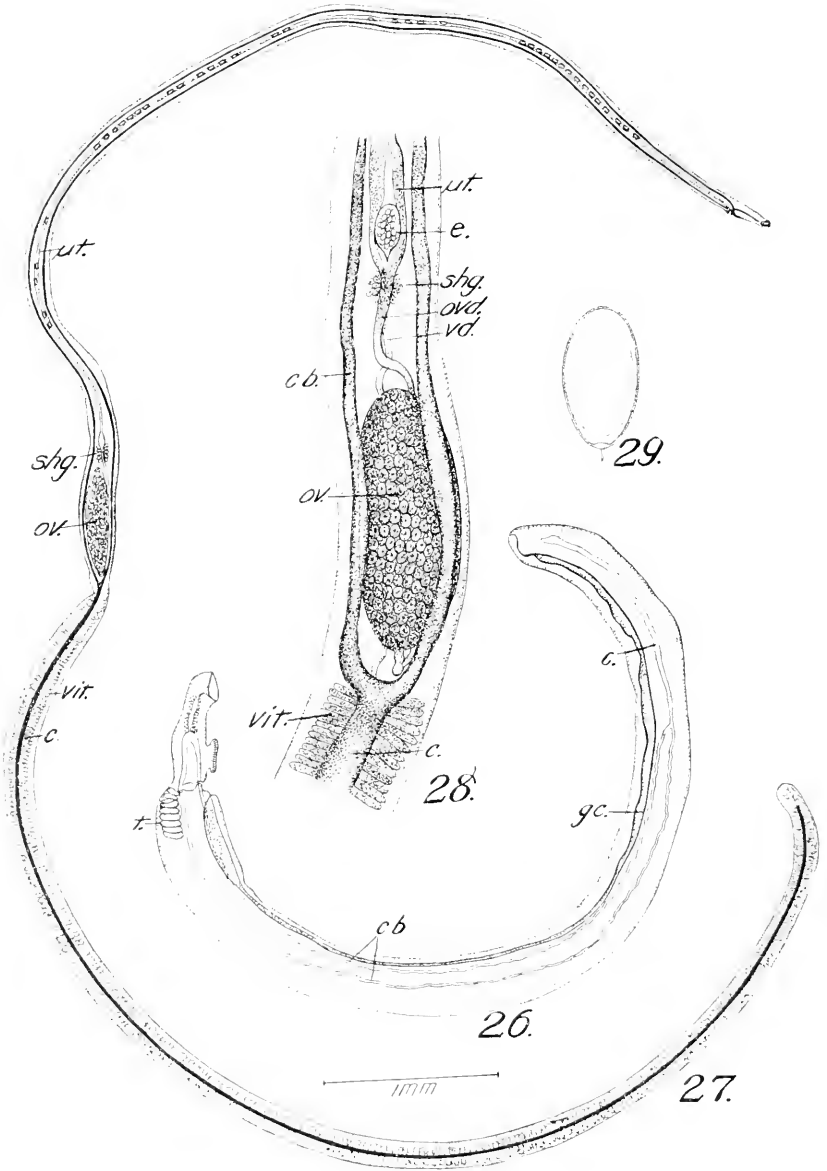
24.



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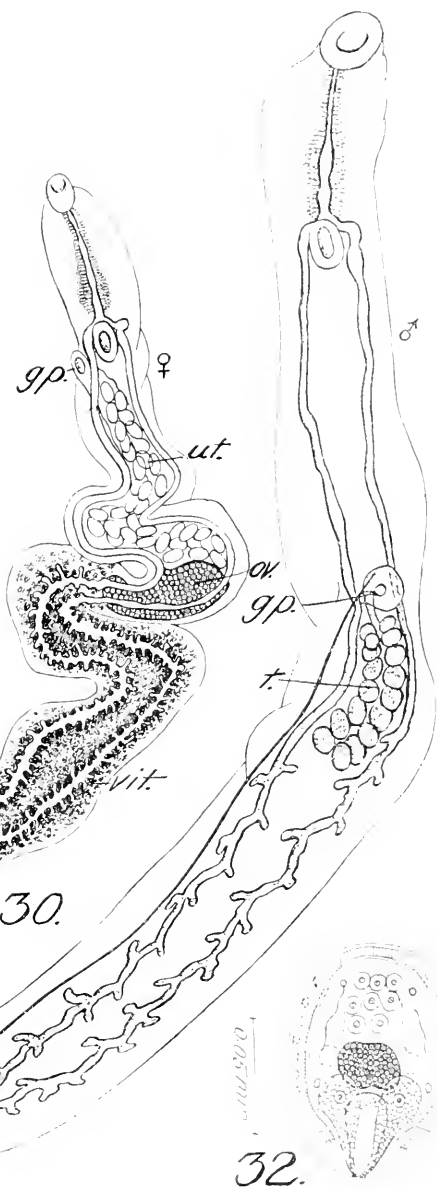
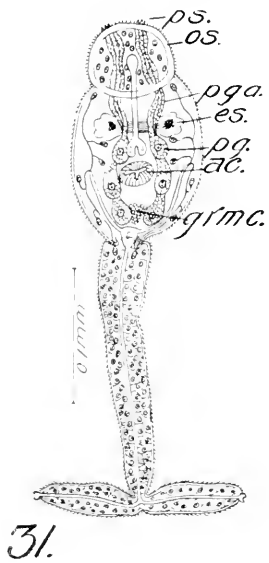
SCHISTOSOMA BOVIS

FOR EXPLANATION OF PLATE SEE PAGE 47



SCHISTOSOMA INDICUM

FOR EXPLANATION OF PLATE SEE PAGE 38



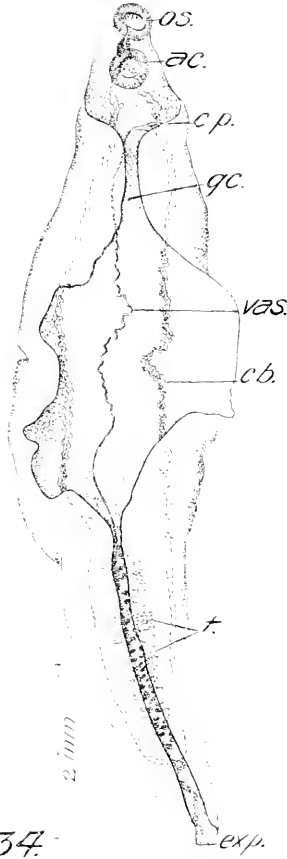
SCHISTOSOMATIUM PATHLOOPTICUM

FOR EXPLANATION OF PLATE SEE PAGE 38



33

2 mm



34

os  
oes.  
ac

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vit.

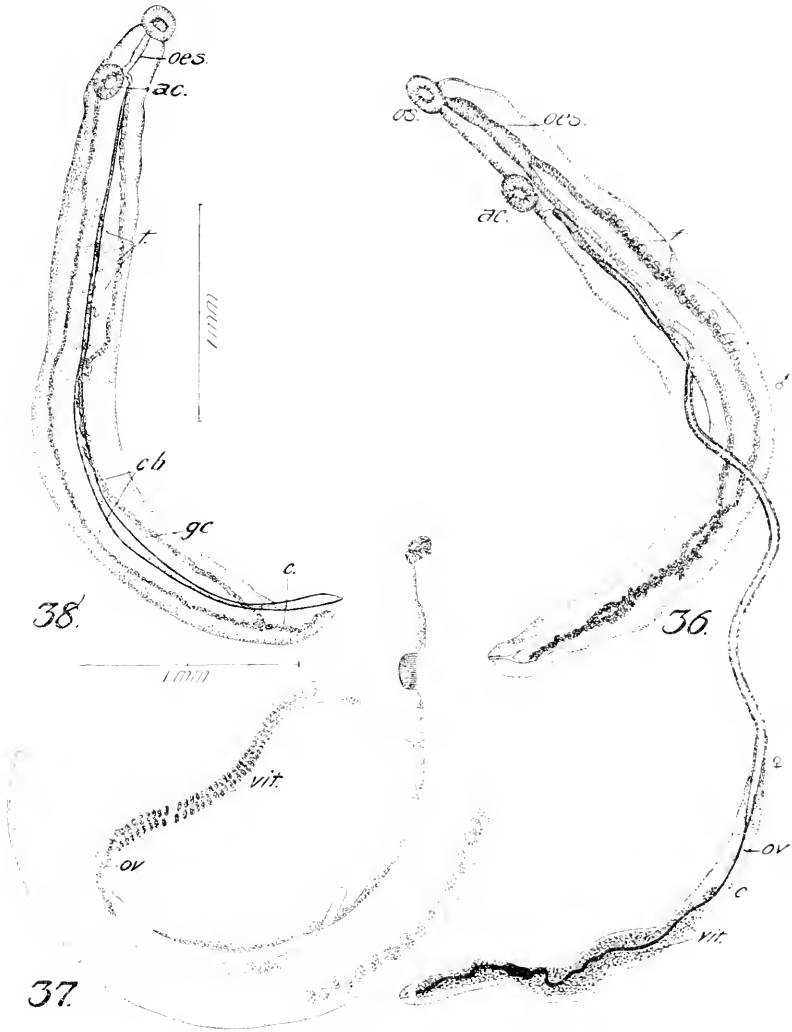
cb.

35 c.

1 mm

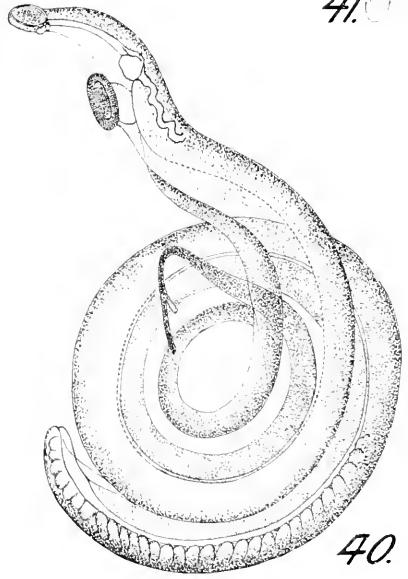
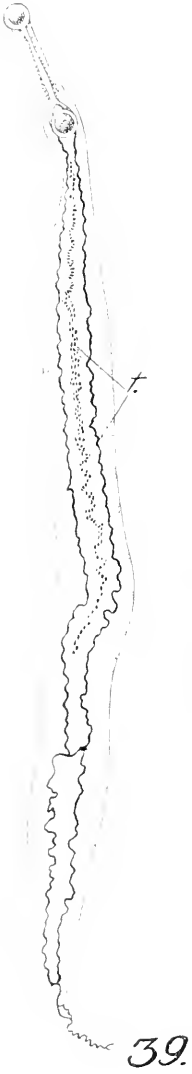
HETEROBILHARZIA AMERICANA AND PARASCHISTOSOMATIUM ANHINGAE

FOR EXPLANATION OF PLATE SEE PAGE 73



AUSTROILHARZIA TERRIGALENSIS AND MICROBILHARZIA CHAPINI

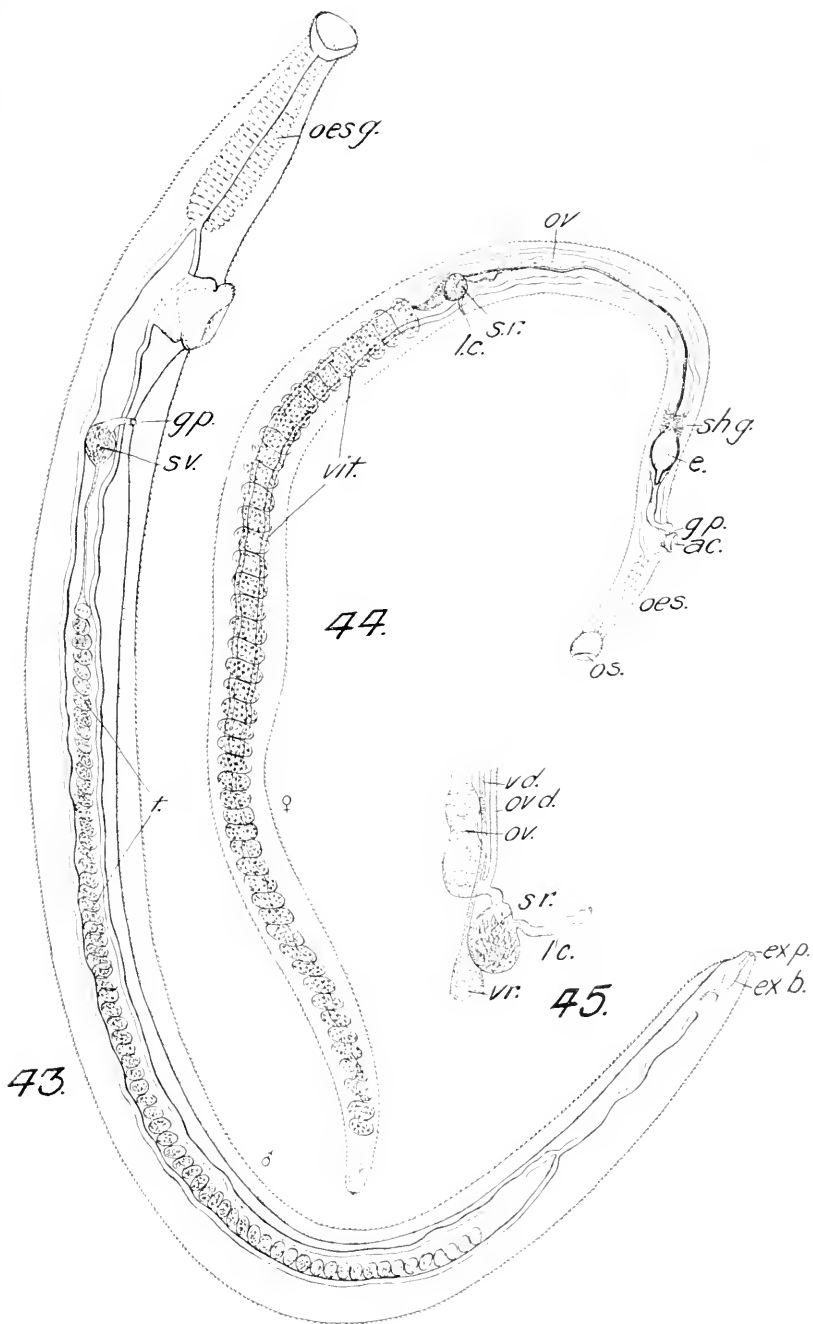
FOR EXPLANATION OF PLATE SEE PAGE 11



ORNITHOBILHARZIA INTERMEDIA. ORNITHOBILHARZIA CANALICULATA, AND ORNITHOBILHARZIA KOWALEWSKII

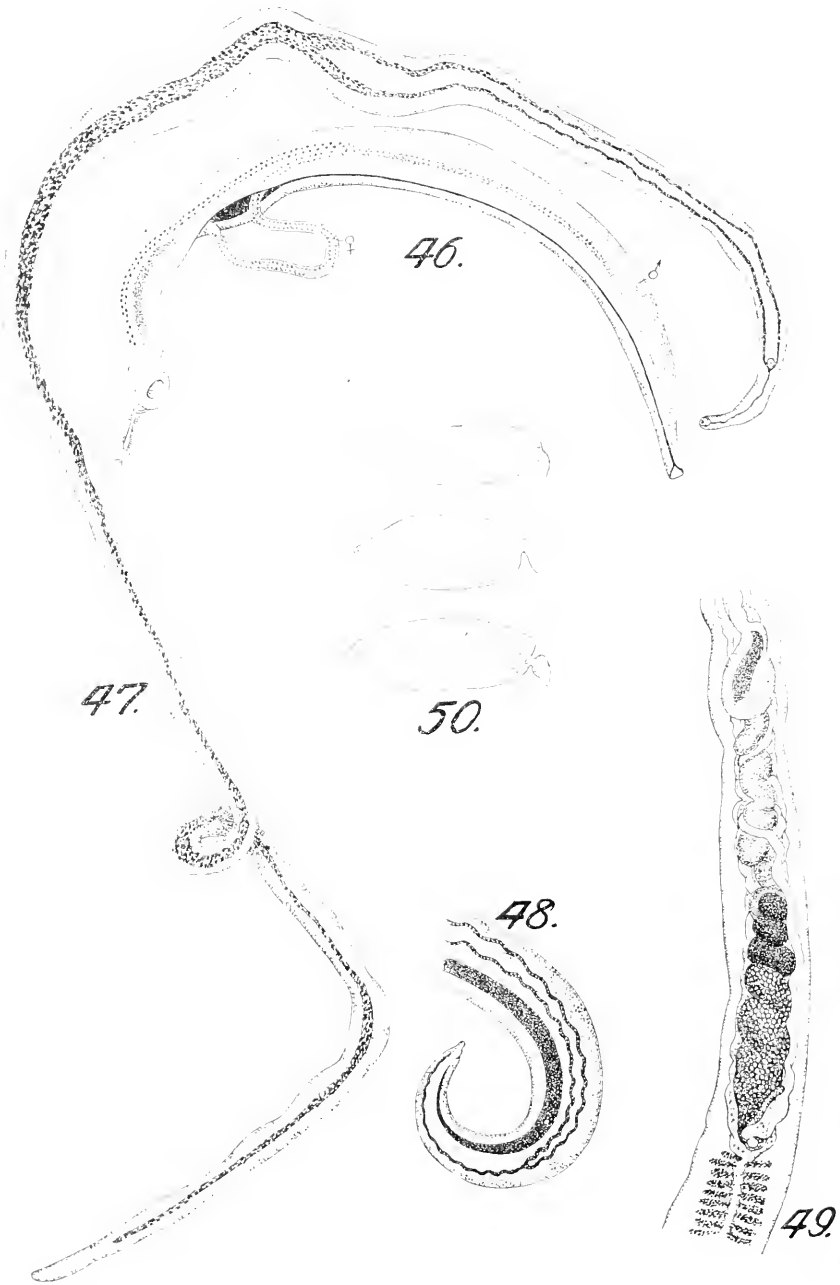
FOR EXPLANATION OF PLATE SEE PAGE 38





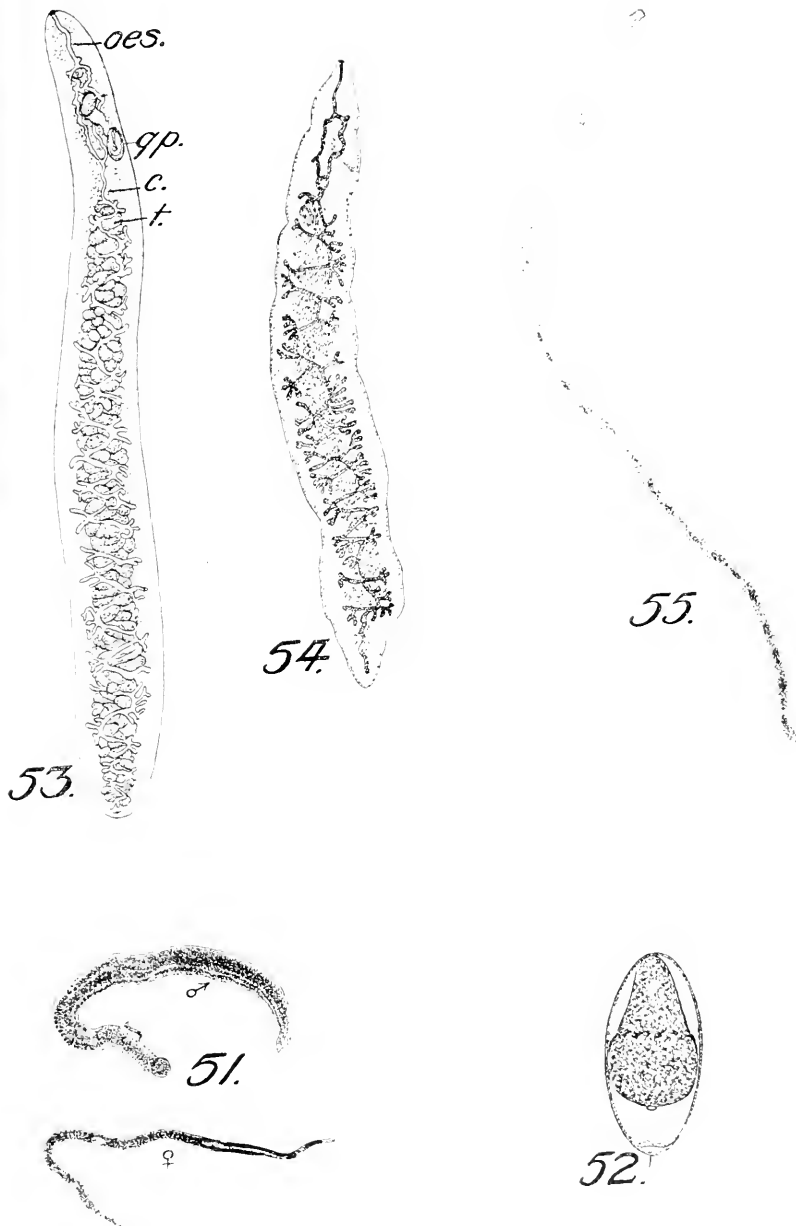
ORNITHOBILHARZIA ODHNERI

FOR EXPLANATION OF PLATE SEE PAGE 38



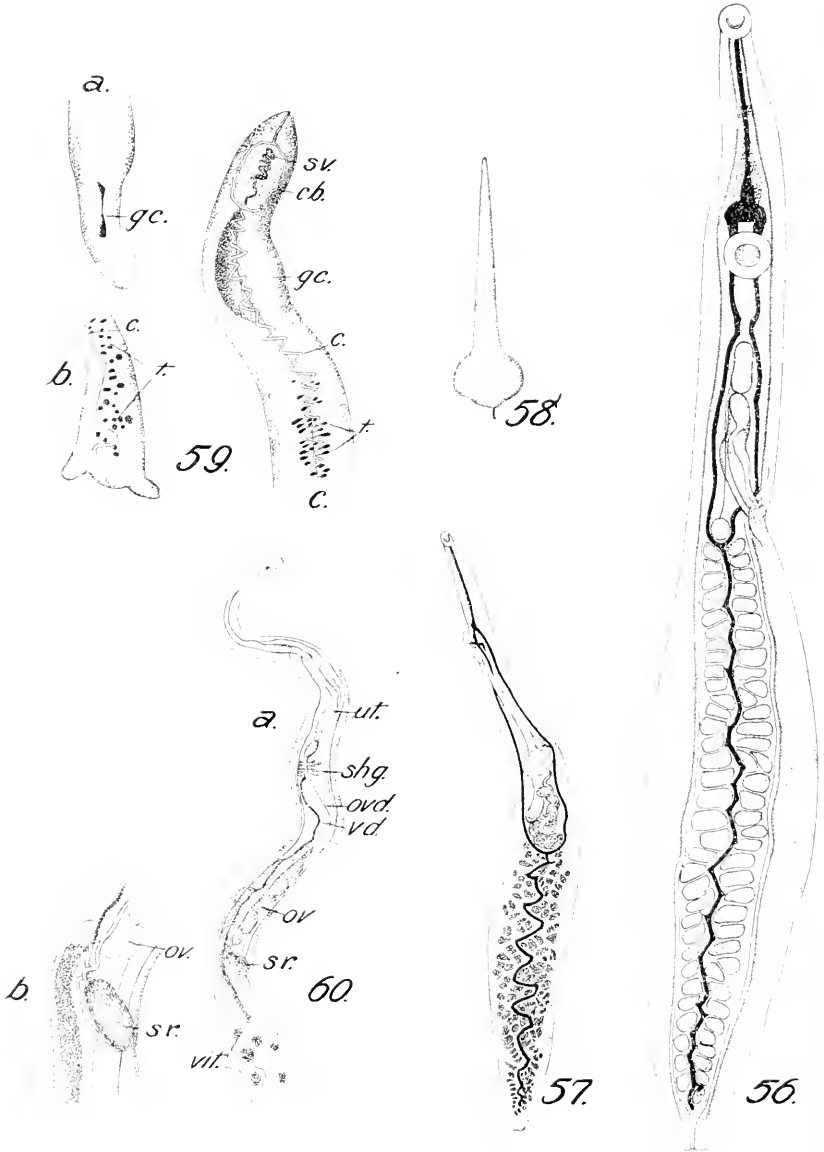
ORNITHOBILHARZIA TURKESTANICUM

FOR EXPLANATION OF PLATE - SEE PAGE 39



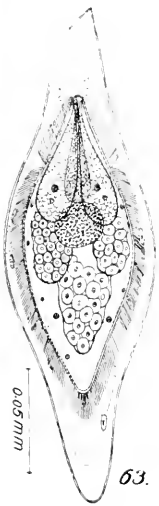
ORNITHOBILHARZIA BOMFORDI, DENDRITOBILHARZIA PULVERULENTA, AND TRICHOBILHARZIA KOSSAREWI

FOR EXPLANATION OF PLATE SEE PAGE 79

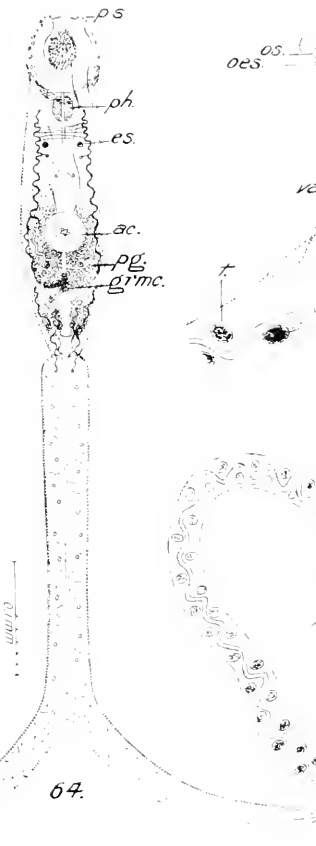


BILHARZIELLA POLONICA AND GIGANTOBILHARZIA ACOTYLEA

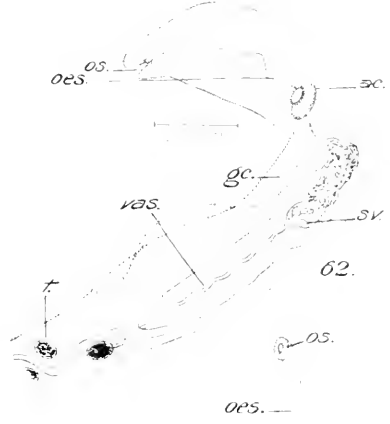
FOR EXPLANATION OF PLATE SEE PAGE 39



63.



64.



62.



61.

BILHARZIELLA YOKOGAWAI

FOR EXPLANATION OF PLATE SEE PAGE 10



# A REVISION OF THE BEETLES OF THE TENEBRIONID TRIBE USECHINI, WITH DESCRIPTIONS OF A NEW GENUS AND NEW SPECIES

By FRANK E. BLAISDELL, Sr.

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The following revision is the direct outcome of having received a most remarkable addition to the tenebrionid tribe Usechini, which was transmitted to me as a loan for study by the late Dr. E. A. Schwarz and Mr. H. S. Barber of the United States National Museum. A careful examination of the morphological characters of *Usechus lacerta* Motschulsky, the only previously known member of the tribe, revealed the need of a revision on account of a number of misstatements in the literature regarding the generic and specific characters.

It is, indeed, most surprising how errors regarding important structural characters have been set forth and perpetuated in works of a systematic nature intended for students' use. Such instances of inaccuracy are coming to light quite frequently under modern methods of study.

In the Classification of the Coleoptera of North America (LeConte and Horn), under the definition of the tribes of the Tentyriinae it is said on page 360, that the eyes in the Usechini are round, and there given in direct dichotomous comparison with the Zopherini, when as a matter of fact the eyes are transverse in both of the tribes; and again, in the descriptive citation of the characteristics of the Usechini it is said (p. 365 of the classification) that the mentum conceals the maxillae at base and the ligula in part, which likewise is not correct for the cardo and stipes visibly fill the buccal fissures in the species described below. Another misleading statement (p. 365) is that regarding the antennae which are described as "ten-jointed, as the eleventh is closely united with the tenth, and is represented only by a pubescent space at the tip of the latter." Such is not the case, however, for the eleventh joint is oval, and more or less feebly transverse and not so closely united to the tenth as to be difficult of observation. In the Revision of the Tenebrionidae of America, Horn repeats the error regarding the eyes (p. 257) but corrects that concerning the eleventh antennal joint (p. 273).

Col. T. Lincoln Casey in his review of the Tentyriinae<sup>1</sup> improved matters, but failed to completely determine the character of the eyes in *Usechus lacerta* Motschulsky and *nucleatus* Casey, no doubt on account of the head of the insects being almost invariably deeply retracted into the prothorax. Even with a good series no attempt was made to extend the head to determine such an important character. Casey differs from Horn regarding the character of the epipleurae, saying that the elytra are without true epipleurae (p. 482 of the above paper). The present writer agrees with Horn in considering that true epipleurae are present and moderately well defined from the elytral disk.

Horn's definition of the family Tenebrionidae has to be modified so as to read: "Anterior coxal cavities *usually closed behind, occasionally more or less open.*" According to his views it might be debatable as to whether or not the Usechini should be retained in the Tenebrionidae. He opposed the European entomologists in retaining *Boros* and *Pytho*, and others in the present family on account of the fact that they have the anterior coxal cavities open behind. It is my opinion that radical changes will have to be made in some parts of the Tenebrionidae when a more critical survey has been made of the genera and species. There is an urgent need for the study of the genitalia of the entire family.

In the classification the family Tenebrionidae is divided into three subfamilies, namely, Tentyriinae, Asidinae, and Tenebrioninae. In the Leng Catalogue it is divided into 22 subfamilies, the Asidinae (Asidini) being given as a tribe in the Tentyriinae. In the sequence of tribes the Usechini follows after the Nosodermini.

### Tribe USECHINI

Body apterous, surface roughly sculptured; mandibles bifid at tip; mentum relatively large, rounded at apex, not concealing the ligula or base of the maxillae; submentum with a spiculiferous puncture (male) at middle near base of mentum; antennae 11-jointed, outer 3 joints forming a club. Antennal fossae marginal and superior, invisible from beneath; eyes not convex, transverse and coarsely faceted. Anterior and middle coxae rather widely separated by the sterna; anterior coxae more or less open behind; middle coxal cavities inclosed by the sterna without trochantin; posterior coxae small, oval, distant; metasternum short, epimera linear; epipleurae entire, more or less moderately defined from the elytral disk, wide at base beneath the humeri. Legs short, tibiae with or without spurs; tarsi without plantar grooves beneath and sparsely clothed with hairs.

<sup>1</sup>Proc. Washington Acad. Sci., vol. 9, 1907 pp. 481-484.



The tribal secondary sexual characters have heretofore been considered obscure. In the male the submentum bears a distinct spiculiferous puncture at middle near the base of the mentum; the spicules short, stout, and rigid.

#### Genus USECHUS Motschulsky

*Usechus* MOTSCHULSKY, Bull. Soc. Imp. Nat. Moscou, vol. 18, 1845, pt. 1, p. 79.

Form oblong-oval, moderately depressed. Eyes concealed in repose, transverse, separated above by a distance about equal to three times their greatest anteroposterior diameter, posterior border nearly straight—very feebly arcuate, very slightly to somewhat distinctly emarginate anteriorly behind the antennae, superior border rounded, truncated below by the prominent obtusely angled lateral border of the genae. The latter visible from above and slightly more prominent laterally than the sides of the front before the eyes. Tempora straight, parallel, and not more prominent than the eyes. Labrum short and transverse.

Antennae stout and gradually incrassate, short, joints closely articulated, basal joint shorter than the second and deeply seated in the antennal fossa; last three joints dilated, slightly compressed, forming a feebly differentiated and closely articulated 3-jointed club. Mandibles rather slender apically, deeply bifid, lobes acute, the superior slightly longer. Antennal fossae not entirely visible from above, but nearly hidden anteriorly by the horizontal sides of the pronotum.

Scutellum minute, often apparently absent, when present slender, entering but feebly between the elytra. Epipleurae flat in subhorizontal plane, rapidly broadening toward the base and more or less distinctly defined by a rough subcariniform line of asperities toward the humeri. Anterior coxal cavities more or less open behind. Tibial spurs apparently obsolete (invisible).

#### USECHUS LACERTA Motschulsky

Plate 1, figures 5, 8, 9

*Usechus lacerta* MOTSCHULSKY, Bull. Soc. Imp. Nat. Moscou, vol. 18, 1845, pt. 1, p. 79, pl. 1, fig. 9.

Form elongate-oval, roughly sculptured. Color black to piceous, or paler according to degree of immaturity; luster dull to slightly shining. Pubescence sparse, yellowish, hairs short and subsquami-form, denser on the summits of the elytral tubercles.

Head and mouth parts small, frontal suture obsolete, epistoma truncate at apex, sides of the front strongly converging and slightly arcuate from the feebly convex supra-antennal convexities, angles moderately rounded. Front scarcely convex, impressed within the sides; moderately coarsely and sparsely punctate above and beneath,

each puncture with a short decurved yellow hair. Antennal club not abruptly formed, ninth joint evidently not quite as wide as the eleventh, the latter transverse.

*Pronotum* as wide as long, widest at middle where the sides are subangulately prominent at end of the antennal fossae, thence strongly convergent and nearly straight to the apex, feebly convergent and slightly arcuate or feebly bisinuate to the basal angles, which are rectangular or feebly prominent laterally and slightly blunt; apex feebly emarginate and the angles obtuse and not prominent anteriorly; base broadly arcuate, sinuate near the angles; disk very moderately convex, impressed along the middle, often more or less obscurely so posteriorly; rather broadly and arcuately impressed and smooth behind the antennal fossae with the lateral margin quite strongly reflexed, anteriorly slightly less so and forming the inner margin of the antennal fossa; surface coarsely but not densely tuberculose

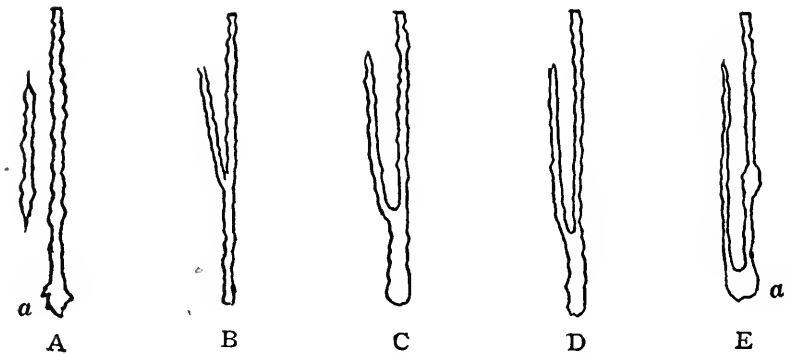


FIGURE 1.—DIAGRAMS SHOWING RELATION BETWEEN THE FIFTH AND SEVENTH COSTATE INTERVALS OF THE ELYTRA IN USECHUS: *a-a*, SUMMIT OF THE APICAL DECLIVITY; A, *LACERTA* MOTSCHULSKY; B, *HORNI* N. VAR.; C, *SANTACLARAE* N. VAR.; D, *TRINITATIS* N. VAR.; E, *NUCLEATUS* CASEY

and with an elongate-oval pitlike depression at middle near the base, and an antebasal transverse impression extending from near the basal angle to the side of the median impression.

*Prosternum* with coarse tubercles like those of the upper surface, each tubercle with a stiff yellow hair. Intercostal process short, horizontal, truncate, and feebly bisinuate at apex, scarcely extending beyond the posterior border of the acetabula; surface impressed at middle of apex and within the lateral margins against the acetabula.

*Elytra* about one-half longer than wide, a little wider than the pronotum; sides parallel to feebly arcuate, broadly sinuate between the tubercle on the lateral margin of the declivity and the apical tumescence. Surface coarsely punctate, punctures in single rows and the alternate intervals costate as follows: Intervals 3, 5, and 9, distinctly costate, the seventh feebly so, but not joining the fifth at

tubercle on summit of the apical declivity (fig. 1, A); third costa entire and bituberculate posteriorly—at summit and middle of the declivity, ending in the apical tumescence; ninth costa submarginal and entire, continuous with the reflexed humeral margin anteriorly and ending in the apical tumescence posteriorly, being distinctly tuberculate at middle of the apical declivity laterally. Interval four not in the least convex, sixth and eighth nearly or quite obliterated, all irregular from the two adjoining series of coarse punctures; the sutural interval becomes distinctly convex at sides of the scutellar depression and attains the basal margin independently of the third, the two expanding on the basal edge and forming a prominent margin. Second and third series of punctures very deep and perforate in the central and basal portion of the disk, each puncture bounded laterally by a small decurved and overhanging tubercle, punctures usually filled with detritus. Intrahumeral impressions asperately sculptured. Scutellar depression scarcely declivous anteriorly, scutellum narrowly triangular, very small, feebly or not at all entering between the elytra.

*Abdomen* with the ventral sutures deeply impressed, apical and basal margins abrupt and more or less crenulate; segments 1, 2, and 3 almost impunctate laterally. Lateral margins of the segments thick, especially that of the fifth at apex; the fifth rather deeply impressed laterally and subcarinate on the median line. Under surface of the body very coarsely punctate. Tarsi short and slender; claws small and slender.

*Male*.—Abdomen very feebly impressed in middle third of segments 1, 2, 3. Surface of fifth segment more strongly impressed laterally, less convex, the impression divided by a median convexity. Posterior margin of the anterior coxal cavities more or less narrowly open.

*Female*.—Abdomen evenly convex. Fifth ventral less broadly impressed and more in the form of a coarse submarginal groove; posterolateral triangular area of the first segment impunctate. Posterior margin of the anterior coxal cavities slightly more widely open.

*Measurements*.—Length 3.1–5.5 mm.; width 1.4–2.1 mm.

*Distribution*.—California (Duncan Mills, Sonoma County, July 16, 1908; Lagunitas, Marin County, September 22, 1912).

*Habitat*.—On fungus and under moldy bark of dead trees where slightly humid.

In addition it may be noted that in *lacerta* the pronotal discal impression behind each antennal fossa is impunctate, that the costate seventh elytral interval ends at basal fifth behind the humeral impression. The sutural rows of punctures attain the margin between the apical tumescences, the latter being mainly in line with the costate third interval; the costate basal parascutellar portion of the sutural interval curves slightly outward around the scutellar impression, the latter rather cavernously unipunctate each side beneath the costae.

The tenth interval on the deflexed side of the elytral disk is invisible from above, slightly costate, joins the epipleural margin just behind the humeri and posteriorly attains the outer part of the apical tumescence. The epipleural margin attains the humeral angle and elytral apex; the submarginal line of punctures is quite entire.

On account of *lacerta* Motschulsky being the type of the genus it has been described in detail. This is necessary to differentiate three other phases that are considered to have racial characteristics.

**USECHUS LACERTA HORNI, new variety**

Plate 1, figures 2, 6

The variety *horni* differs from *lacerta* Motschulsky in its smaller size and feebly convex alternate elytral intervals. The elytral tubercles are entirely obsolete or feebly developed. The seventh elytra costa (fig. 1, B) joins the fifth at about apical third of costa and the sixth interval is obsolete anterior to the union; eighth interval obsolete between the two rows of serial punctures internal to the costate ninth interval, the latter not in the least tuberculate at sides of the apical declivity, although in some specimens an incipient tubercle may be present. Anterior coxal cavities more or less open posteriorly.

The antennal club is narrower, joints 10 and 9 quite equal, eleventh more rounded and scarcely longer than wide.

*Measurements*.—Length (type) 3.8 mm.; width 1.25 mm.

*Type locality*.—California (Duncan Mills on the Russian River, Sonoma County). Collected on July 16, 1908, by the writer. A small series studied. Type a male in the author's collection. Paratypes in the United States National Museum and California Academy of Sciences collections.

*Paratypes*.—Cat. No. 40378. U.S.N.M., from Santa Cruz Mountains, Calif. (Koebele).

**USECHUS LACERTA SANTAFLARAE, new variety**

Plate 1, figure 7

Form rather more robust than *lacerta* Motschulsky less parallel and less roughly sculptured. Color castaneous to nigro-piceous. Antennae less heavy, club more abruptly formed and there is a greater and more noticeable difference between the width of the eighth and ninth joints; the ninth and tenth very nearly equal in width and length; eleventh slightly transversely oval. Prothoracic basal impressions usually deep. The tubercles formed by union of the fifth and seventh convex elytral intervals more elongate on summit of the declivity. (Fig. 1, C.)

*Measurements*.—Length (type) 6 mm.; width 2.2 mm.

*Type locality*.—Santa Clara County, Calif. Four specimens without other data in the Van Dyke collection. Type a male and paratype in the collection of the California Academy of Sciences, and one in the author's collection. A paratype has also been deposited in the collection of the United States National Museum in Washington. Other specimens from the Koebele collection are in the California Academy of Sciences and in the United States National Museum.

*Paratype*.—Cat. No. 40379, U.S.N.M.

*Distribution*.—Santa Cruz Mountains of California.

USECHUS LACERTA TRINITATIS, new variety

Less elongate and rather more robust than *lacerta* Motschulsky, surface less roughly sculptured. Sides of the prothorax more prominently angulate across the extremities of the antennal fossae, thence more strongly convergent anteriorly to the apex. Pronotal disk quite strongly sculptured, median groove broad, well defined by prominent borders and basal impression rather deep.

Elytral sides more arcuate, the intervals nearly as in *lacerta*: third most pronounced on the apical declivity, seventh joining the fifth (fig. 1, D) at about middle, thence quite prominent to opposite tubercle of ninth; sixth interval slightly indicated between the strial punctures, ninth very feebly angulate laterally at side of the declivity. Discal punctures very coarse in the first four series.

Antennal club less strongly developed than in *lacerta*. Ninth and tenth joints about equal in length and width, the eleventh more rounded, about as long as wide and scarcely as wide as the tenth. First ventral segment feebly but distinctly impressed at middle.

*Measurements*.—Length (type) 4.5 mm.; width 1.6 mm.

*Type locality*.—Trinity County, Calif. Collected on January 17, by E. R. Leach. Two specimens studied, holotype, male and allotype, female. Types in the author's collection to be deposited in the collection of the California Academy of Sciences.

The variety *trinitatis* might correctly be considered a subspecies, but on account of the small number of specimens studied it has been thought best to give it a minimum grade.

USECHUS NUCLEATUS Casey

Plate 1, figure 1

*Usechus nucleatus* CASEY, Ann. New York Acad. Sci., vol. 5, p. 176. Mar. 1890.

Form very much smaller in size, less elongate and relatively broader than *lacerta* Motschulsky. Color brown-black to piceo-testaceous and duller in luster. Pubescence sparse, consisting of slender yellow subsquamiform hairs, denser on or at site of the tubercles.

Head finely and sparsely punctate. Eyes transverse, rather broadly rounded above, broadly and very feebly emarginate behind the antennae. The latter less stout than in *lacerta*; first two joints a

little longer than wide, second as long as wide, others subequal in length and slightly transverse; ninth and tenth more prominent anteriorly; eleventh oval and about the same length as the tenth.

Pronotum nearly similar to that of *lacerta*, but with the median discal impression more or less obsolete near the middle, with basal pit deeper and rather more circular. The latter bounded laterally by rather prominent margins that are somewhat faceted lateroposteriorly at point of contact with the basal elytral processes.

The antennal fossae extend further posteriorly than in *lacerta* to a little distance behind the middle; their inner margin very moderately reflexed. Disk broadly impressed behind the fossae and within the reflexed lateral margin; the impressions extend inward along the basal margin to the sides of the basal pit, are shallow and not abruptly formed, with surface subglabrous.

Prosternal process truncate and flush with the posterior border of the coxal cavities, as well as strongly margined against the acetabula.

Elytra coarsely sculptured, punctures large in regular series and moderately deep. Intervals more or less discernable throughout between the rows of punctures; the third, fifth, seventh, and ninth rather moderately subcostate in greater part of their length; the third being so for its entire length and terminating in the apical tumescence, much thickened at base and joining the feebler parascutellar ridge from the sutural interval, the two together forming a moderately prominent and anteriorly projecting short process that overhangs the basal pronotal margin, evidently abutting against the dorsolateral facet on side of the basal pit when the prothorax is retracted against the elytral base; laterally the process is continuous with the basal margin, but abruptly formed medially, somewhat flattened and moderately arcuate at apex. The second interval is not convex anteriorly and is lost between the first and third behind the basal process; seventh interval (fig. 1, E) is moderately costate, beginning just behind the intrahumeral impression and terminating posteriorly with the fifth in a small tuberculiform swelling at summit of the apical declivity. The sixth and eighth intervals are noticeably feebly convex, but irregular from the adjacent striae punctures; ninth is costate throughout and submarginal and not tuberculate at side of the apical declivity. The epipleural margin on the deflexed sides of the elytra meets the ninth interval at the humeral angle. The humeral margin is moderately reflexed and the angle obtuse; the intrahumeral impressions are glabrous as well as the triangular periscutellar space which is slightly anteriorly declivous and usually quadripunctate. The scutellum is minute, elongate, and enters but feebly or not at all between the elytra.

Abdomen almost impunctate toward the sides, especially in the lateroposterior portion of segments one and two, which are much

more finely punctured elsewhere, except on the basal segment; impressions of the fifth only moderately marked. The first segment is very broadly, feebly flattened at middle and between the coxae, where the punctures are large, circular and shallow. The metasternal surface between the four acetabula is distinctly and broadly impressed with edges of the area slightly raised.

*Male*.—Submentum with a spiculiferous puncture. Middle of the ventral abdominal segments slightly but appreciably impressed, the impressed area gradually diminishing in extent from the second toward the fifth; the latter more strongly impressed and feebly pitlike at the sides within the marginal bead.

*Female*.—Submental puncture obsolete or minute. Middle third of the first ventral segment impressed as in the male, the following segments being evenly convex from side to side; the fifth more convex at middle and less impressed as a whole within the thick marginal bead, the lateral pitlike depressions being smaller but noticeable.

*Measurements*.—Length 2.9–4.3 mm.; width 1.18–1.6 mm.

Six specimens studied. Casey's types have been deposited in the United States National Museum. Two of the four specimens believed to be paratypes, given long ago by Col. T. Lincoln Casey to Dr. E. A. Schwartz, were kindly transmitted to me for study and contributed to the above revision of Casey's description. The type has recently been examined by the author during a visit to the Museum in Washington. Two other specimens from the same museum are from Oregon (Linell collection) and the State of Washington (Morrison). The two other specimens were received as a loan from Professor Beamer of the entomological department of the University of Kansas. Casey writes that he had a large series before him at the time he described the species, but I am informed that his series now consists of 14 specimens, the labels of 3 of which indicate "Hoopa Valley, Trinity River, Humboldt County (Fort Gaston)" (the type locality), 1 indicates Arcata in the same county, and 10, which he probably considered duplicates unworthy of complete labels, bear only the State label "Cal." He overlooked the basal elytral processes. Casey's type is illustrated by photograph. Plate 1, figure 1.

In *nucleatus* all of the elytral intervals are more or less recognizable. It has therefore served as a criterion for the determination of the intervals in *lacerta* where part of the intervals are obsolete on account of the closeness of the striae punctures.

#### USECHIMORPHA, new genus

Form subquadrato-oblong. Eyes deeply concealed in repose, transverse, anterior and posterior borders parallel, quite straight and not emarginate anteriorly, distinctly narrower than in *Usechus* Mots-

chulsky, and equal in width throughout, except at the upper border where they are subacute and slightly arcuate anteriorly; lower border truncated by the prominent lateral edge of the genae, separated on the vertex by a distance less than twice their own width. Labrum well developed.

Antennae not stout, funicle rather slender, joints three to seven equal in width, eighth widest and truncated at apex as seen from below; terminated by a well formed, short oval and somewhat compressed 3-jointed club; eleventh joint much smaller than the tenth and rounded at apex. Mandibles not deeply emarginate at tip, lobes short, subobtuse and subequal. Tempora rather long, straight, parallel, very feebly convergent posteriorly, less prominent than the

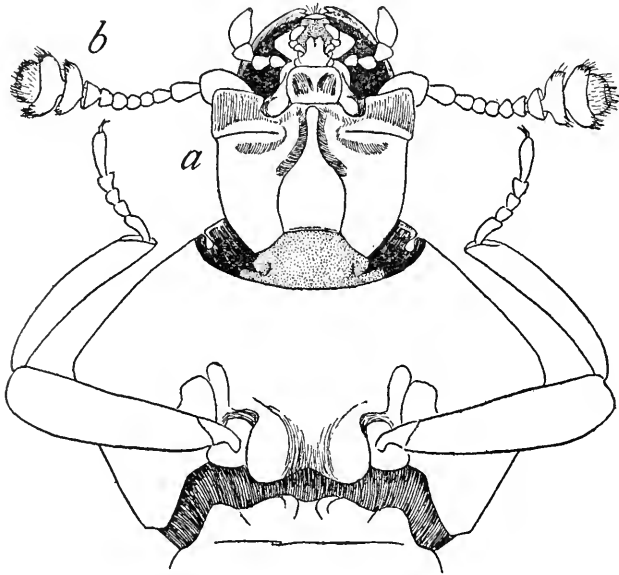


FIGURE 2.—*USECHIMORPHA BARBERI*. *a*, HEAD FULLY EXTENDED AS SEEN FROM BENEATH; *b*, ANTENNA, BASAL JOINT NEARLY CONCEALED BY THE GENIAL PLATE

lateral border of the genae, the latter slightly wider than long and visible from above. The head widest between the anterolateral angles of the genae. Antennal fossae rather large, open, dorsal and marginal, wholly visible from above.

Anterior coxal cavities widely open posteriorly, prosternal process broad. Scutellum very small, elongate and entering for a short distance between the elytra at base. Intercoxal process of the first abdominal segment broad, truncate between the coxae. Tibial spurs small, slender, and distinct.

In *Usechimorpha* there is in the median line of the submentum, near to base of the mentum, a moderately coarse spiculiferous puncture;



spinule short and stout and probably a male character. A similar structure occurs in the species of *Usechus*.

*Genotype*.—*Usechimorpha barberi*, new species.

USECHIMORPHA BARBERI, new species

Plate 1, figures 3, 4

Color rufo-piceous, surface abundantly clothed with small decurved yellowish, slender scalelike hairs; surface more or less coated with a light gray scaly substance.

Head and mouth parts relatively small. Epistomal region before the antennae depressed, obsoletely sculptured and sparsely pubescent, abruptly and arcuately limited above by the raised surface of the front before the eyes; epistomal apex broadly arcuate between the feeble sinuations at the positions of the oblique sutures, angles moderately rounded with the sides of the front, surface feebly convex. Front between and anterior to the eyes obsoletely sculptured and glabrous; vertex finely and subasperately sculptured. Labrum transverse, arcuate at apex, surface with few punctules and very fine hairs. The sharp lateral borders of the genal plates are visible from above and the basal joint of the antennae at apex is nearly flush with it. Head in repose retracted to the raised frontal line.

Antennae clavate, length slightly greater than the width of the head across the eyes; basal joint less than twice as long as wide, second scarcely longer than wide, third to the seventh, inclusive, subequal in size and form, about as long as wide, short and subcylindrical; eighth wider, scarcely longer, flaring and acutely margined at apex; joints two to eighth, inclusive, form a rather slender funicle. Ninth and tenth joints strongly transverse, the former twice as wide as the eighth, tenth a third wider than the ninth, the tenth rather deeply and arcuately emarginate receiving the smaller eleventh joint. Joints ninth, tenth, and eleventh forming a slightly compressed, oval club.

*Pronotum* as long as wide, widest at about middle across the apices of the antennal fossae and there broadly angulate, thence the lateral edge of the antennal fossae is straight, convergent, slightly declivious anteriorly but not extending as far forward as the inner border of the fossa, straight posteriorly and equally convergent to the obtuse basal angles; base rather strongly arcuate and apparently finely margined; basal angles more acutely rectangular beneath the more superficial obtuse line; apex truncate in feeble circular arc between the slightly rounded angles; disk irregularly convex, narrowly impressed along the median line from the apex, becoming more broadly so behind the middle, rather arcuately declivious anterolaterally forming the inner boundary of the antennal fossae which are wholly visible from above as the result; surface obscurely quadritumescent,

deeply impressed behind the fossae within the somewhat thickened and more or less reflexed lateral margins, deeply and transversely impressed at middle before the basal lobe, continuously so with the lateral impressions.

*Elytra* about a third longer than wide, about as wide as the pronotum, sides parallel in basal three-fifths and slightly arcuato-undulate, thence moderately convergent to apex which is not broadly rounded; base feebly emarginate and adapted to the pronotal base; humeri moderately rounded and not tumescent; surface irregular from rather large incipient oval tubercles, which become most pronounced at and on the upper apical declivity, there are also discernable two lateral and a median one on each elytron, the former being most conspicuous. A small depression within each humerus is usually present.

*Ventral surface* of the body pubescent as above. Prosternum not tuberculose although rather irregular, the propleurae obscurely subtuberculose; prosternal process slightly emarginate at apex; metasternum somewhat broadly impressed in the central area. Abdominal sutures not excavated, first and second feebly arcuate, fifth ventral not impressed. Legs rather short and slender; tarsi slender.

*Measurements*.—Length 3.2 mm.; width 1.4 mm.

*Holotype*.—Cat. No. 28851, U.S.N.M.

*Type locality*.—Near Eureka, Humboldt County, Calif.

Described from a single specimen, a male, deposited in the collection of the United States National Museum, Washington, D. C.

Collected by H. S. Barber, to whom the species is dedicated. He writes concerning the specimen as follows: The beetle was taken while "sifting leaf-litter in a coniferous woods along a road 2 miles east of the center of Eureka, Humboldt County, Calif. It was taken together with the similarly obscure colydiid *Megataphrus*."

*Usechimorpha barberi* stands as an example of what can be obtained by careful sifting, a method of collecting nearly entirely neglected of late. Collectors desire larger and more spectacular things, something to make a show. Sifting may be irksome but it is less strenuous. Among the microcoleoptera are found some of the most marvelous and curious forms.

A synoptical statement of the differential characters for separating the genera and species of the *Usechini* described above may be given as follows:

KEY TO GENERA OF USECHINI

Antennae with a feebly differentiated club; funicle stout; epistomal region of the head convex; anterior coxal cavities more or less imperfectly closed behind..... *Usechus* Motschulsky

Antennae with a well formed oval club; funicle slender; epistomal region distinctly impressed; anterior coxal cavities widely open behind.

*Usechimorpha*, new genus

The species of the genus *Usechus* may for the present be separated in the following manner:

## KEY TO SPECIES OF USECHUS

Elytral base without processes overhanging pronotal base; surface roughly sculptured; elytral intervals in part obliterated by juxtaposition of the coarse serial punctures.

Form elongate, parallel, coarsely sculptured; seventh costa discrete, rarely joining the fifth, ninth, or pseudomarginal costate interval strongly tuberculate at side of apical elytral declivity; antennal funicle stout, eleventh joint wider than long.....*lacerta* Motschulsky

Form relatively broader, much less roughly sculptured; costate seventh interval joining fifth at tubercle on summit of declivity, tubercle long; costate ninth interval simply angulate at side of declivity; antennal funicle stout, eleventh joint as in *lacerta*.....*santaclarae*, new variety

Form small, relatively robust, less roughly sculptured; costate intervals devoid of tubercles (type), or tubercles incipient; costate seventh interval joining fifth at middle of elytra; antennal funicle less stout, eleventh joint scarcely transverse.....*horni*, new variety

Form similar to *nucleatus*, relatively more robust, sides more arcuate, much less roughly sculptured as in *santaclarae*; costate seventh interval joining fifth at tubercle, the latter elongate; costate ninth interval angulate at side of declivity; ninth and tenth antennal joints less transverse, club as long as wide.....*trinitatis*, new variety

Elytral base with short processes overhanging pronotal base; elytral intervals more or less distinct between the rows of punctures; costate seventh interval joining fifth at tubercle, the latter round; costate ninth interval feebly tuberculate at side of apical declivity.....*nucleatus* Casey

As a final test of the stability of certain characters it was found that out of 26 *lacerta* Motschulsky, 20 had the costate seventh interval discrete; in 4 that interval joined the fifth, while in 2, the seventh was discrete on one side and joined the fifth on the other.

In 10 specimens of *Santaclarae*, the seventh interval joined the fifth in all except 1, in that one the seventh was discrete. In this variety the tubercle of the seventh is elongate and ridgelike, while in *lacerta* it is shorter and rounded. The differential characters appear to hold in a series and differ no more than in other species, subspecies, and varieties.

There is no question regarding the specific distinctness of *lacerta* and *nucleatus*. Typical *horni* is unique. Larger series are needed for study.

On account of the difficulty of obtaining Motschulsky's works it is thought best to give his descriptions of the species involved in the present paper as an addendum.

## ADDENDUM

The following is an excerpt of Motschulsky's writings, 1845:<sup>2</sup>

## 228. USECHUS m. nov. gen.

Hétéromère. Les quatre antérieurs de cinq, les postérieurs de quatre articles; dernier article des tarses presque de la longueur de tous les précédents ensemble. Tête petite, chaperon arqué, recouvrant en grande partie la lèvre supérieure et les mandibules; yeux cachés sous le chaperon. Palpes courtes et larges, dernier article ovoidal. Antennes n'atteignant pas le milieu du corselet, moniliformes avec les trois derniers articles en massue tronquée. Corselet beaucoup plus large et plus long que la tête, avec une cannelure profonde de chaque côté pour recevoir l'antenne. Elytres presque parallèles, convexes et couvertes d'élevations et d'inégalités comme celles des *Bolitophagus* et *Endophloeus*. Fascies des *Endophloeus*.

USECHUS LACERTA. m. Tab. 1. fig. 9-9'. [See Plate 1, fig. 5.]

Elongatus, convexus, cribratus, squalidus, brunneus, parce setulosus; capite minuto thorace subquadrato, antice angustato, lateribus reflexis, crenulatis; scutello triangulari; elytris carinatis, interstitiis elongato scrobiculatis, carinis postice in verrucae productis.

Long. 2½ lign. Larg. 1 lign.

Il ressemble par sa taille et ces couleurs à *l'Endophloeus exculptus* Parreys, mais les côtes sur les élytres sont moins relevées et les excavations latérales, qui reçoivent complètement les antennes redressées en arrière, le font facilement reconnaître.

Il m'a été envoyé comme venant de Californie."

Plate 1, fig. 9-9'. The figure is hand colored, dull brown and shows no more than the photograph [Plate 1, fig. 5] shows.

## EXPLANATION OF PLATE

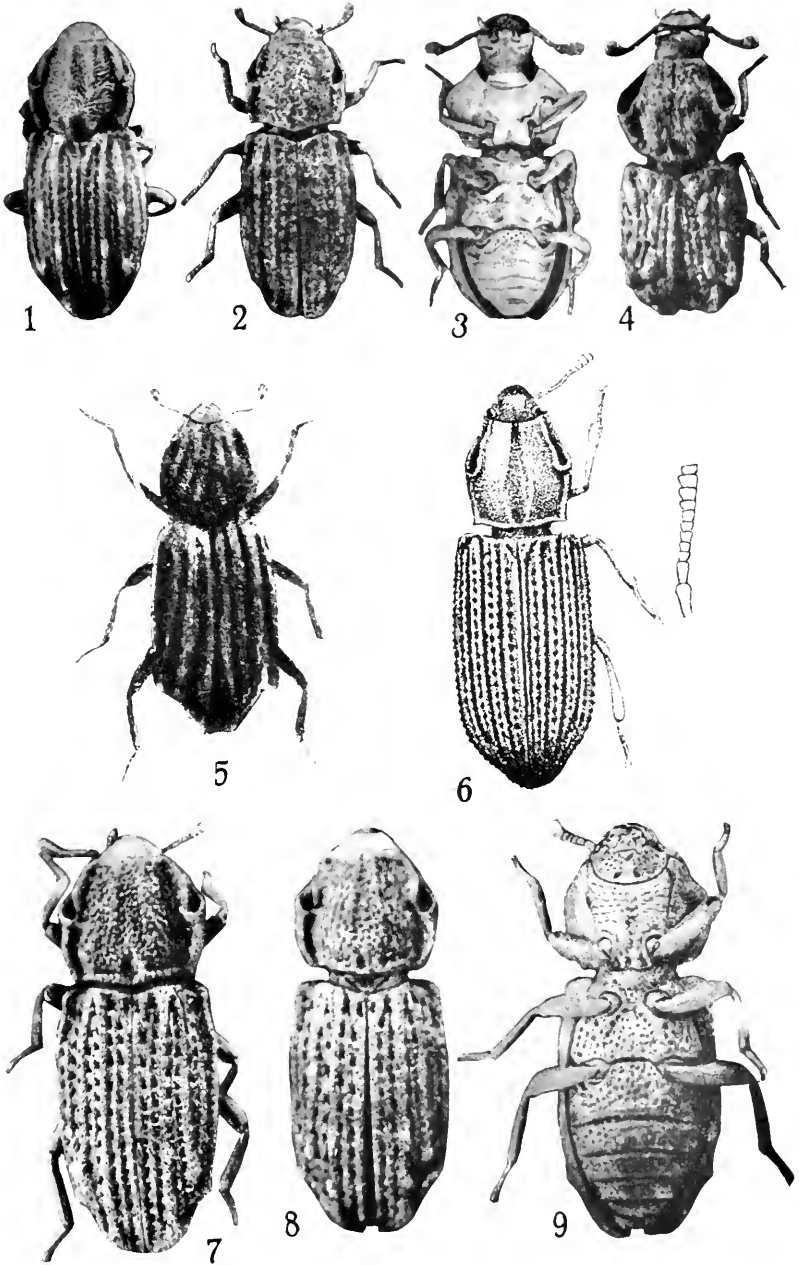
(Photographs by H. S. Barber)

Figures enlarged about 10-13 diameters

- FIGURE 1. *Usechus nucleatus* Casey. Type.  
 2. *Usechus lacerta horni* Blaisdell. Paratype from Santa Cruz Mountains, California.  
 3-4. *Usechimorpha barberi* Blaisdell. Type. Ventral and dorsal aspects.  
 5. *Usechus lacerta* Motschulsky. Enlargement of original hand-colored figure. (Bull. Soc. Imp. Moscou, 1845, vol. 18, pl. 1, fig. 9.)  
 6. *Usechus lacerta horni* Blaisdell. Enlargement of figure by Horn (Trans. Amer. Philos. Soc., vol. 14, pl. 15, fig. 5) there called *lacerta* Motschulsky.  
 7. *Usechus lacerta santaclaræ* Blaisdell. Paratype.  
 8-9. *Usechus lacerta* Motschulsky. Dorsal and ventral aspects of a specimen from Lagunitas, Marin County, Calif.

<sup>2</sup> Bull. Soc. Imp. Nat. Moscou, vol. 18, p. 79.





VARIOUS SPECIES OF USECHUS AND USECHIMORPHA

FOR EXPLANATION OF PLATE SEE PAGE 14



# TAPEWORMS OF THE GENERA RHABDOMETRA AND PARUTERINA FOUND IN THE QUAIL AND YELLOW-BILLED CUCKOO

By MYRNA F. JONES

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## INTRODUCTION

The type material (U.S.N.M. Cat. No. 5151) of *Taenia odiosa* Leidy, 1887, until recently the only cestode reported from *Colinus virginianus*, is here redescribed and the species transferred to the genus *Rhabdometra*. This material, obtained for study through the courtesy of Dr. J. Percy Moore, of the University of Pennsylvania, consists of several entire strobilae and numerous fragments, in all about two dozen specimens. Various sections as well as toto mounts were made and examined by the writer.

Leidy's original description of *Taenia odiosa* is as follows:

Head hemiovoidal to conical, unarmed; bothria subterminal, spherical, near together; neck none; body immediately after as wide or nearly as wide as the head; anterior segments short, linear; succeeding segments all wrinkled annularly, the more anterior bandlike, the posterior barrel shaped. Generative apertures lateral, mostly not visible. Length  $\frac{1}{2}$  to 2 inches. Head 0.3 to 0.45 mm. wide; body just behind about as wide as the head; anterior segments 0.05 long; succeeding segments 0.15 long by 1 to 1.25 wide; at widest part of body, 0.5 long by 1.625 wide; posterior segments 1.25 long by 1.25 wide. From the intestine of the quail, *Ortyx virginianus*, four birds of the same brood.

## EXTERNAL MORPHOLOGY

The Leidy specimens vary in length from 20 to 50 mm., with a maximum width of 2 mm. Four scolices (figs. 1, 2) measure 255 $\mu$ , 325 $\mu$ , 330 $\mu$ , and 400 $\mu$  in diameter, their suckers measure 120 $\mu$ , 150 $\mu$ , 150 $\mu$ , and 180 $\mu$ , respectively, and are unarmed; no rostellum is present. A short neck is evident or indistinct, according to the state of contraction. In most specimens all segments are broader than long; however, most of the worms are longitudinally contracted; a few elongate segments, median or posterior in the strobila of specimens not so contracted, indicate that this is a decidedly variable feature (figs. 3, 4). A few gravid segments are as much as five times longer than broad.

## INTERNAL MORPHOLOGY

*Nervous system.*—The fairly prominent longitudinal nerves (fig. 7) lie exterior to the excretory canals, and in cross section appear to interrupt the inner layer of muscle-fiber bundles.

*Musculature.*—The longitudinal muscles (fig. 7) are arranged distinctly in an inner and an outer layer, each layer consisting of numerous bundles of fibers, a total of 40 or more. Transverse and dorsoventral muscles are but weakly developed.

*Excretory system.*—There are the usual small dorsal excretory canal and larger ventral excretory canal on either side (fig. 7). Anteriorly, they are approximately the same size. The transverse canal in the posterior portion of the segment is prominent, and a few supplementary transverse canals are observable, but these do not seem to make up a reticulate system such as Ransom describes for another rhabdometrid, *Rhadometra nullicollis*. The genital canals pass between the longitudinal excretory canals and dorsal to the longitudinal nerve (fig. 7).

*Male reproductive organs.*—The testes (figs. 5, 6, 7) are posterior in the segment, and posterior and lateral to the ovary. They vary in number from 12 to 25 in the segments of a single strobila, the usual range being from 16 to 22. In no case were more than 25 observed. Well-developed testes are usually transversely elongate and measure about 75 by 45  $\mu$ . The vasa efferentia are indistinct; the vas deferens is prominent and in the anterior portion of the segment. The cirrus is comparatively straight in the cirrus sac, the straight region being 160 to 180  $\mu$  long, and is armed with small spines for a distance of about 60 $\mu$  from its tip. The large cirrus pouch (figs. 5, 7) passes median of the longitudinal excretory canals, and extends diagonally toward the anterior portion of the segment. In mature segments it varies from 195 to 225  $\mu$  long by 45 to 60  $\mu$  wide, more rarely to 300 $\mu$  by 52 to 60  $\mu$ ; in gravid segments the cirrus pouch (figs. 2, 4), though distinct, is usually smaller, ranging from 165 to 195  $\mu$  in length.

*Female reproductive organs.*—The vagina (figs. 5, 6) is posterior and dorsal to the cirrus pouch. The enlarged distal portion, 135 to 195  $\mu$  long by 35 to 45  $\mu$  wide, is followed by a narrow tubular proximal portion 4 to 6  $\mu$  in diameter, and that in turn by an ovoidal or cylindrical seminal receptacle (figs. 5, 6, 7). The ovary (figs. 5, 6, 7) is median (equatorial) or postmedian (postequatorial) in position, and is bilobed when mature. The vitelline gland (figs. 5, 6) is posterior and ventral to the ovary, and between them lies the small so-called shell gland (fig. 7). The uterus (figs. 5, 6, 7), originally situated anterior and dorsal to the ovary, invades and comes to occupy the space previously occupied by the ovary before the latter degenerates;



the uterus at that earlier stage is somewhat spherical, while in the gravid segment it is tubular and longitudinally elongate (figs. 3, 4). The parauterine organ develops anterior to the uterus. As is usual with this structure, it first appears as a denser region of the parenchyma (figs. 5, 6); later there may appear in connection with this area a solid mass projecting back into the developing uterus. In gravid segments the parauterine organ appears as a tubular organ extending from the uterus nearly to the anterior margin of the segment. At the point of contact there is typically a projection (or contraction) of the parauterine organ back into the uterus (fig. 4).

The onchospheres in the uterus measure 28 to 30  $\mu$  in diameter, with embryonic hooks approximately 16 $\mu$  in length. No ova were observed in the parauterine organ.

#### SYSTEMATIC POSITION

These specimens have the generic characters of *Rhabdometra* which are as follows: Paruteriniinae: Scolex unarmed, without rostellum. Genital pores irregularly alternate. Genital canals pass between longitudinal excretory vessels. Testes posterior and lateral to female glands. Uterus median, tubular, and elongate longitudinally, or globular. A parauterine organ develops anterior to the uterus and extends forward nearly to the anterior border of the segment.

Six species of *Rhabdometra* have been described previously. One species, *R. similis*, considered by the writer to belong in the genus *Paruterina*, is discussed in an appended note. The accompanying chart will serve to distinguish the specific characters and to compare *R. odiosa* with the five known species. Based on the characters shown on the chart the following key may be made:

A. Genital pore posterior to middle of segment margin.

1. Testes few (12)..... *R. nigropunctata*.

2. Testes numerous (about 60)

(a) Testes posterior and lateral to female glands; cirrus pouch extending beyond midline of segments; genital canals dorsal to longitudinal nerve..... *R. numida*.

(b) Testes surrounding female glands (contrary to generic diagnosis); cirrus pouch not reaching midline of segment..... *R. cylindrica*.

B. Genital pore anterior to middle of segment margin.

1. Testes few (about 12 to 30)..... *R. tomica*, *R. odiosa*.

2. Testes numerous (about 60)..... *R. nullicollis*.

Distinguishing *R. tomica* (Kolodkovsky, 1906) from *R. odiosa* (Leidy, 1887) is difficult. *R. tomica* has 20 to 30 testes "or more"; *R. odiosa* has 12 to 25, as many as 30 never having been observed. The cirrus pouch of *R. tomica*, as estimated from drawings, is some-

RHABDOMETRA SIMILIS RANSOM, 1909. TRANSFERRED TO GENUS  
PARUTERINA

*Rhabdometra similis* Ransom, 1909, was described originally from material lacking scolices. Linton (1927) reported *R. similis* from the same host, *Coccyzus americanus*, from which the earlier material was collected and described the scolex as bearing a double crown of small hooks on the rostellum. In so far as was possible, toto mounts of Linton's material were compared by the present writer with the type material of *R. similis*; mature and gravid segments of the two are similar, showing no more than ordinary variation within a species. Linton writes that sections of the more recent material agree in detail with the transverse section of *R. similis* as described by Ransom (1909, fig. 24).

The generic diagnosis of *Rhabdometra*, subfamily Paruterinae, includes the character of a scolex which is unarmed and without rostellum, while the genus *Paruterina* differs from *Rhabdometra* chiefly in the occurrence of a rostellum armed with a double row of hooks. *R. similis* is found to fit the generic diagnosis of *Paruterina* in all respects, and to be distinguishable from other described species of that genus by the size and number of hooks, position and size of cirrus pouch, and the number of testes. In addition to having an armed scolex, *R. similis* is found to differ consistently from all other species of *Rhabdometra* in having comparatively few, only 20 to 24, bundles of fibers in the inner layer of longitudinal muscles. It is of interest that this condition is definitely described for a species of *Paruterina*, *P. angustata* Fuhrmann, 1906. It is concluded that *R. similis* should be transferred to the genus *Paruterina* as *Paruterina similis* (Ransom, 1909) Jones, 1929 (the present paper).

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## EXPLANATION OF PLATE

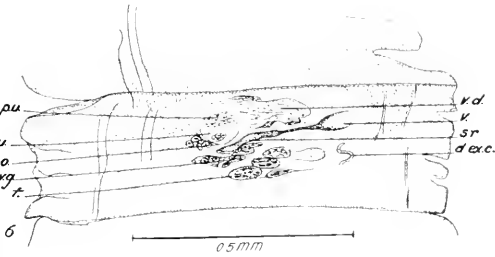
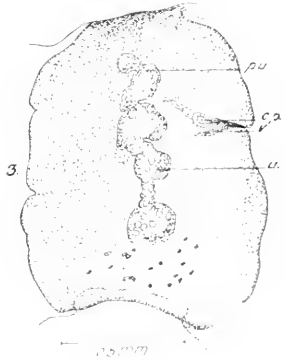
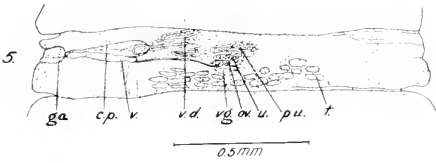
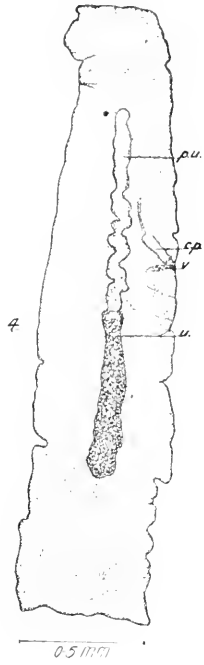
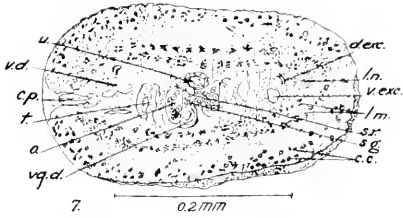
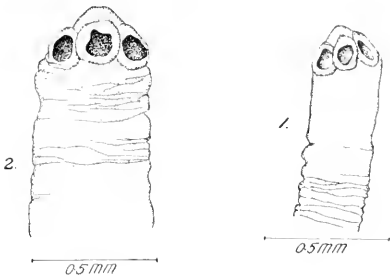
- FIGURE 1.—Head and anterior portion of one strobila.  
2.—Head and anterior portion of a second strobila.  
3.—Gravid segment, contracted.  
4.—Gravid segment, elongate.  
5.—Mature segment. Toto mount.  
6.—Mature segment. Frontal section.  
7.—Mature segment. Transverse section.

## RHABDOMETRA ODIOSA

*c c*—calcareous corpuscles.  
*c p*—cirrus pouch.  
*d exc*—dorsal excretory canal.  
*g a*—genital aperture.  
*l m*—longitudinal muscle.  
*l n*—longitudinal nerve.  
*o (ov)*—ovary.  
*pu*—parauterine organ.  
*s g*—shell gland.

*s r*—seminal receptacle.  
*t*—testis.  
*u*—uterus.  
*v*—vagina.  
*v d*—vas deferens.  
*v ex c*—ventral excretory canal.  
*v g*—vitelline gland.  
*v g d*—duct from vitelline gland.





RHABDOMETRA ODIOSA

FOR EXPLANATION OF PLATE SEE PAGE 8



# A NEW SPECIES OF TREMATODE WORMS BELONGING TO THE GENUS HASSTILESIA FROM RABBITS IN TEXAS

By ASA C. CHANDLER

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In the upper third of the small intestine of a specimen of *Sylvilagus floridanus alacer*, collected at Houston, Tex., were found a large number of flukes which prove to be a new species of *Hasstilesia*, for which the name *Hasstilesia texensis* is proposed.

## HASSTILESIA TEXENSIS, new species

*Specific diagnosis.*—*Hasstilesia*; small worms, oval or elliptical in outline, slightly pointed at the ends, 0.55 to 0.86 mm. long, 0.40 to 0.53 mm. broad, and 0.24 to 0.33 mm. thick, varying greatly in the proportions of length, breadth, and thickness according to the degree of contraction. The majority of the specimens are ellipsoid in cross section, the mean maximum measurements of cross sections being 0.44 by 0.29 mm., but some specimens are relatively thicker and others relatively broader. Fresh specimens appear a dirty rusty white in color, and do not show the three distinct shades described by Stiles and Hassall (1894) in *H. tricolor*. The entire cuticle is beset with minute spines, from  $4\mu$  to  $10\mu$  in length, but the spines are much denser on the anterior than on the posterior part of the body. In many whole mounts the spines drop out in the process of fixation and staining and can not be seen.

The oral sucker is terminal, with the opening anterior or very slightly ventral; it is relatively much larger than in *H. tricolor*, and broader than long. It measures from  $115\mu$  to  $132\mu$  in transverse diameter. The ventral sucker is slightly smaller, measuring from  $105\mu$  to  $120\mu$  in diameter; it is further posterior than in *H. tricolor*, its center being from 0.21 to 0.34 mm. from the anterior end. In most specimens the center is very slightly posterior to the junction of the anterior and middle thirds of the body. In one small specimen measuring  $540\mu$  in length and  $450\mu$  in breadth the center of the acetabulum is  $240\mu$  from the anterior end.

The digestive tract consists of the oral sucker, pharynx, and intestinal ceca. The pharynx lies immediately behind the oral

sucker, is nearly spherical, and measures about  $50\mu$  to  $60\mu$  in diameter. There is no esophagus, since the pharynx opens directly into the anterior portions of the intestinal ceca which form a transverse tube about  $200\mu$  long; this tube bends posteriorly at its distal ends to continue as the posterior portions of the intestinal ceca. The latter pursue an irregular wavy course near the lateral margins of the body, but medial to the yolk glands. The transverse portion just behind the pharynx may be slightly curved so that the lateral shoulders are very slightly more anterior than the part of the tube into which the pharynx opens. At the posterior end of the body the ceca curve dorsally and medially and end very close together; in one sectioned specimen the walls of the posterior extremities of the ceca are in contact.

The excretory system opens by a minute pore toward the dorsal side of the posterior extremity. From this a fine tube leads forward, enlarging into a small reservoir, and then branching to right and left.

The testes are on different planes. The right testis lies medially in the posterior part of the body, while the left one is situated well on the left side of the body between the posterior testis and the acetabulum. The position of the left testis varies; in some specimens the anterior border of the testis lies on a level with or even slightly anterior to the posterior border of the acetabulum, while in others it is distinctly posterior to this, but it is always somewhat nearer to the acetabulum than to the right testis. The testes are round or slightly oval, never lobate, and measure  $105\mu$  to  $140\mu$  or more in diameter. Usually the anterior testis is slightly larger than the posterior one, but this is not invariably the case. The cirrus is an extremely large and powerful organ, and when extruded is very conspicuous in fresh specimens. The extruded cirrus in one of the writer's specimens measures  $140\mu$  in length with a diameter of  $50\mu$ . In one specimen loaned by Doctor Francis it is still larger. The cirrus pouch into which it is retracted is very long and cylindrical, pursuing a more or less wavy course anteriorly and terminating near the posterior border of the acetabulum. The proximal portion is surrounded by a large mass of prostate glands. The vas deferens leading from the anterior testis to the proximal end of the ejaculatory duct is short and direct; the one leading from the posterior testis could not be followed in either whole mounts or sections. The cirrus and uterus open side by side in the posterior part of the body, the cirrus near the median line, and at the level of the ovary, and the metraterm to the left. The genital openings are nearer to the posterior end of the body than to the posterior border of the acetabulum, and not more than  $200\mu$  to  $250\mu$  from the posterior end.



The ovary is situated on the right side of the body between the two testes, but somewhat nearer the posterior one. It is round, oval or somewhat triangular in shape, not lobate, and measures about  $88\mu$  to  $100\mu$  in transverse diameter and somewhat less dorso-ventrally. The shell gland is situated just medial to the ovary, and is connected with the latter by a short oviduct; the shell gland is relatively large, having a diameter of about  $60\mu$  to  $65\mu$ . Posteriorly it gives off the rather well-developed Laurer's canal which turns and runs straight dorsally. The vitellaria are much less abundant than in *H. tricolor*, and occupy a rather narrow lateral area from just behind the level of the pharynx to about the level of the ovary. The ducts cross the body at about the level of the ovary and shell gland and form a small triangular reservoir where they meet near the latter organ. The ducts can not be followed in whole mounts and their course is very difficult to follow in sections. The uterus is extremely thin-walled, and its convolutions can not be followed in either whole mounts or sections. In sections the eggs appear to be scattered through the body, the thin-walled uterine tubes being indistinguishable from spaces in the parenchyma. The eggs are most numerous in the part of the body between the anterior testis and the oral sucker, on the left side posterior to the posterior testis, and between the testes, but in no specimens are the eggs solidly massed as is the case in specimens of *H. tricolor* which I have examined, and as they have been figured and described by Stiles and Hassall. The terminal part of the uterus, where it opens beside the cirrus, is thick-walled and conspicuous in sections, but this portion, which runs antero-medially from the genital pore, is short and soon loses its distinct wall. The eggs are oval, about  $21\mu$  to  $22\mu$  long by  $13\mu$  to  $15\mu$  broad.

*Host*.—East Texas cotton-tail rabbit, *Sylvilagus floridanus alacer*, and Texas jack rabbit, *Lepus texianus* (collected by Francis); in small intestine.

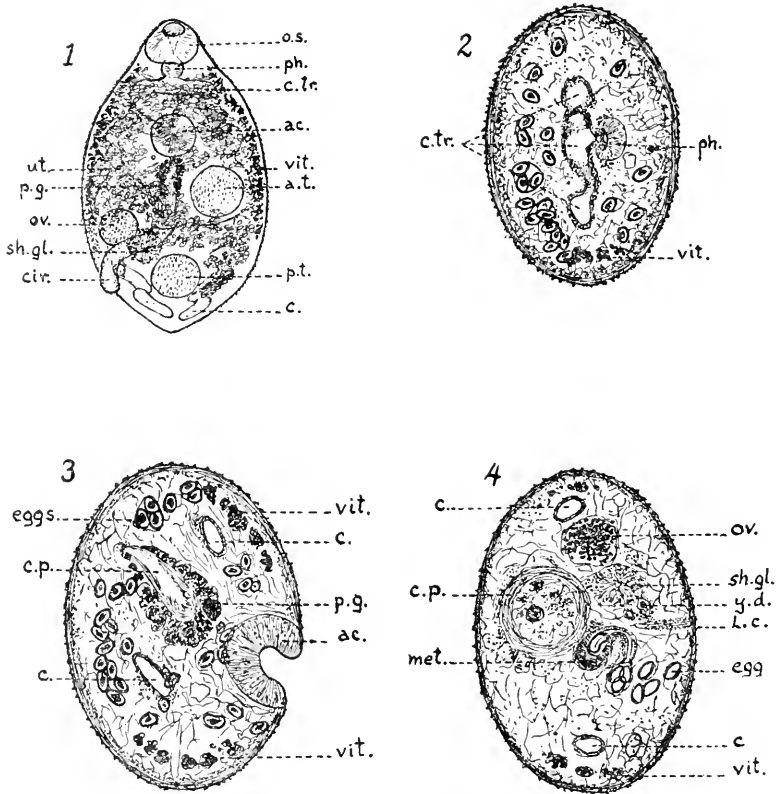
*Locality*.—Houston, Tex. (Chandler), and College Station, Tex. (Francis).

*Type specimens*.—Cat. No. 8026, United States National Museum Helminthological Collections; paratypes, Cat. No. 8027.

This fluke is clearly closely related to *Hasstilesia tricolor*, which was first described by Stiles and Hassall (1894) from *Lepus americanus* and *L. sylvaticus* from Maryland to Virginia, and later reported by Hall (1916) as being reported from Long Island, N. Y., and also from jack rabbits at College Station, Tex. (reported by Doctor Francis of the Texas A. and M. College). Doctor Francis very kindly sent me a slide of the specimens collected from jack rabbits for comparison with my specimens and with *H. tricolor*. They conform in every detail, except the size of the testes, which is very variable anyway, with my Houston specimens. The geographic range of *H. tricolor* is

therefore limited to the middle eastern seaboard States so far as is known at present, while *H. texensis* is so far known only from eastern Texas.

*Hasstilesia texensis* differs in a number of respects from *H. tricolor* and is undoubtedly specifically distinct. The principal and most striking differences are in the size of the suckers and in the formation



FIGURES 1-4.—1, *HASSTILESIA TEXENSIS*.  $\times 83$ . 2, CROSS SECTION OF SAME THROUGH TRANSVERSE PORTION OF INTESTINAL CECA.  $\times 166$ . 3, CROSS SECTION OF SAME THROUGH POSTERIOR PART OF ACETABULUM AND ANTERIOR PORTION OF CIRRUS POUCH.  $\times 166$ . 4, CROSS SECTION OF SAME JUST ANTERIOR TO GENITAL OPENINGS AT LEVEL OF LAURER'S CANAL.  $\times 166$ .

ABBREVIATIONS: *ac.*, ACETABULUM; *a. t.*, ANTERIOR TESTIS; *c.*, INTESTINAL CECUM; *cir.*, CIRRUS; *c. p.*, CIRRUS POUCH; *c. tr.*, TRANSVERSE PORTION OF INTESTINAL CECA; *L. c.*, LAURER'S CANAL; *met.*, METRATERM; *o. s.*, ORAL SUCKER; *ov.*, OVARY; *ph.*, PHARYNX; *p. g.*, PROSTATE GLANDS; *p. t.*, POSTERIOR TESTIS; *sh. gl.*, SHELL GLAND; *ut.*, UTERUS; *vit.*, VITELLARIA; *y. d.*, YOLK DUCT.

of the uterus in adult specimens. Stiles and Hassall give the diameter of the oral sucker as  $88\mu$  to  $112\mu$ ; in two specimens kindly loaned from the United States National Museum Helminthological Collections the sucker measures  $93\mu$  and  $87\mu$  transversely and  $69\mu$  and  $74\mu$  in length, respectively. The specimens have a total length of  $710\mu$  and  $745\mu$  and a breadth of  $565\mu$ . In specimens of *H. texensis* of

equivalent size the oral sucker measures  $120\mu$  to  $128\mu$  transversely and  $86\mu$  to  $115\mu$  in length. The acetabulum is also markedly larger and situated farther posteriorly. The loose arrangement of the uterine coils as compared with the solid massing of eggs in *H. tricolor* is very marked. The sizes of the testes and ovary are also different. In the two specimens of *H. tricolor* mentioned above, which were lent for comparison, the posterior testis measures  $236\mu$  by  $157\mu$  in one and  $248\mu$  by  $133\mu$  in the other. In my specimens of *H. texensis* the posterior testis is much more nearly round, with a diameter of from  $110\mu$  to  $115\mu$ , but in Doctor Francis's specimens the posterior testes are more oval and measure from  $170\mu$  to  $228\mu$  in the larger, transverse, diameter. This slide was prepared over 30 years ago and the testes may have become considerably compressed, as may also be the case with Stiles and Hassall's specimens. Other differences exhibited by *H. texensis* are the very much larger size of the extruded penis ( $80\mu$  by  $32\mu$  in *H. tricolor* and  $140\mu$  to  $200\mu$  by  $40\mu$  to  $60\mu$  in *H. texensis*); the absence of an esophagus between the pharyngeal bulb and the bifurcation of the ceca; the less profuse and more scattered vitellaria; the unusual development of the prostate glands; and the very distinct Laurer's canal.

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# PAGECRINUS, A NEW CRINOID GENUS FROM THE AMERICAN DEVONIAN

By EDWIN KIRK,  
*Of the United States Geological Survey*

Among the unworked and unstudied material of the Springer collection in the United States National Museum a tray of crinoids was found representing a new and interesting genus. The material was apparently acquired by purchase, but from what collection it came can not be determined. The original locality label bears the legend "Niagara group, St. Paul, Ind." A label in Mr. Springer's handwriting gives the horizon as "Onondaga Gr." and the locality as "Near St. Paul, Ind." This change in horizon was probably based on information acquired subsequent to the purchase while Mr. Springer was making an intensive study of the Silurian crinoids. The Onondaga age of the material is further assured through the determination of a number of well-preserved Bryozoa associated with the crinoids by Dr. R. S. Bassler.

## PAGECRINUS, new genus

The genus is represented by a single known species, *Pagecrinus gracilis*, new species, and of necessity the generic diagnosis is drawn up from information furnished by this form.

*Pagecrinus* is a dicyclic inadunate crinoid, the affinities of which seem closest with the family group Botryocrinidae as defined by Bather. The relatively huge basals, the structure of the posterior interradius and ventral sac, and the arm structure are strikingly like the Carboniferous genus *Belemnocrinus*. *Belemnocrinus* is generally considered a monocyclic genus, but it may eventually prove a pseudo-monocyclic form derived from just such a Devonian ancestor as *Pagecrinus* by the apparent elimination of the infrabasals.

The genus will probably be found to comprise only species of small size. The dorsal cup is high, subcylindrical in form, and of small diameter. The infrabasals are relatively large. The basals in proportion to the dimensions of the cup are very large. The radials are very small. In the type species the arms bifurcate typically on

the fourth primibrach, though one arm of each of two specimens has the bifurcation on the third primibrach. The two rami thus formed are of equal size and remain simple. Long, stout ramuli are borne by the rami on alternate sides on each second brachial. The food-grooves of the arms are covered by two rows of small interlocking ambulacrals. In the posterior interradius there is one anal plate in the cup. This is plate  $\times$ , which is of approximately the same size and proportions as the adjacent radials. The ventral sac is relatively heavy and round in cross section. In its basal portion on the posterior side there is a median line of heavy plates, four or five in number, scarcely to be distinguished from brachials except for the fact that they are somewhat narrower. It is only by careful cleaning and examination that  $\times$  with its sequence of heavy median tube plates can be distinguished from a radial and its series of primibrachs. The surest test in these small specimens is the relation of plate  $\times$  to the basals. The radials, of course, alternate with the basals, while  $\times$  rests squarely on the upper truncated face of the posterior basal. The column is round and tapers slightly for a short distance distad. It then maintains a uniform diameter so far as seen. The column is composed of alternating thick and thin columnals, with a tendency toward a grouping into nodals and internodals.

*Genotype*.—The genotype is *Pagecrinus gracilis*, new species, the only known species referable to the genus.

*Horizon*.—The type species is from the Middle Devonian of Indiana.

PAGECRINUS GRACILIS, new species

Of this form four reasonably complete crowns in an excellent state of preservation, two less perfect crowns, and several fragmentary specimens showing details of arm-structure are available for study.

The species is a small one, one of the largest crowns giving a height over all of but 20 millimeters. In this specimen the dorsal cup is 5.5 millimeters in height. Further measurements of this specimen are as follows:

|   | mm. |
|---|-----|
| Diameter of dorsal cup at base of arms..... | 2.3 |
| Diameter at base of dorsal cup.....         | 1.6 |
| Height of IBB.....                          | 1.9 |
| Width of IBB.....                           | 1.1 |
| Height of BB.....                           | 2.7 |
| Width of BB.....                            | 1.3 |
| Height of RR.....                           | 1.2 |
| Width of RR.....                            | 1.1 |
| Height of anal $\times$ .....               | 1.1 |
| Width of anal $\times$ .....                | .9  |

As shown by measurements, the dorsal cup is slender and tapers slightly from the upper margin to the base.

The infrabasals are pentagonal in outline and are relatively large. The basals are very large in proportion to the size of the cup and the other constituent plates. All are hexagonal in outline except the posterior, which is heptagonal. In the case of the posterior basal the normal acute angle above is truncated to act as a base of support for plate  $\times$ . The radials are pentagonal in outline and are relatively very small in size. The radial facet extends the full width of the radial and shows at the surface as a straight horizontal line. Anal  $\times$  is of about the same height as the radials and somewhat narrower. It is quadrangular in outline. In one specimen there appears to be a low plate equal in width to  $\times$  and lying between  $\times$  and the posterior basal. This plate may not have an existence in fact but be due to a very regular horizontal fracture of  $\times$ . There are no signs of it in any other specimen where the posterior interradius is shown.

The arms bifurcate regularly on the fourth primibrach, giving rise to two equal rami, which in turn bear ramuli. In the right anterior ray of one specimen the arm branches on the third primibrach, and in another specimen the third primibrach is axillary in the right posterior ray. This seems to be a sporadic variation, not having been seen in any other specimens examined. The ramuli are long and stout and are borne on alternate sides on each second secundibrach. The ventral groove of the arm is covered by two rows of small slightly overlapping and interlocking ambulacrals. They average about three in number to each side of an arm ossicle.

The ventral sac is of about the length of the arms and in its distal portion is stout and circular in section. In its proximal portion on the dorsal side is a median row of heavy plates, scarcely to be distinguished from arm ossicles, except that they are somewhat narrower and shorter. Above, the tube is made up of five or six vertical rows of fairly large plates. In one specimen the ventral sac apparently curves outward between the arms and extends some 7 millimeters beyond the crown. Whether this is normal can not be told. This specimen was lifted from the rock in an effort to determine its structure, but without success. In another specimen which has its posterior interradius exposed the ventral sac can be traced for a distance of 9 millimeters. It then apparently plunges downward into the rock as if assuming a horizontal attitude. It seems probable that the ventral sac does normally have this flexed form and assumes a horizontal attitude at about one-half its height.

*Horizon and locality.*—All of the known specimens come from the Jeffersonville limestone (of Middle Devonian—Onondaga age) near St. Paul, Ind.

*Types.*—The types are in the Springer collection in the United States National Museum.

## EXPLANATION OF PLATE

*Pagecrinus gracilis*, new genus and species

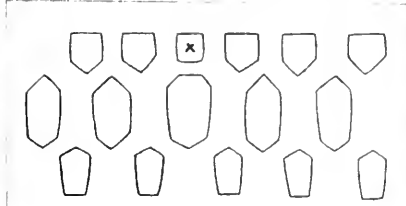
- FIG. 1. Large specimen  $\times 2$ , view from the left posterior radius, showing the striking similarity of the basal portion of the ventral sac and the arms.
2. Specimen  $\times 2$  showing proximal portion of the column and three primibrachs in the right anterolateral radius.
3. Specimen  $\times 2$  as seen from the posterior interradius showing basal portion of ventral sac and three primibrachs in the right posterior radius.
4. Specimen  $\times 2$  showing ventral sac curving outward and extending for some distance horizontally beyond the arms.
- 5-6. Details of arm fragments  $\times 3$ , showing ramules.
7. Generic diagram of cup-plates  $\times 4$ .







5



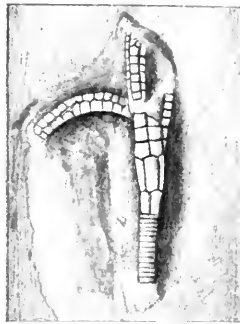
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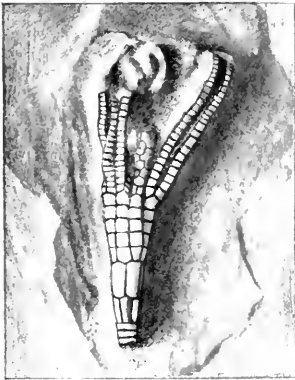
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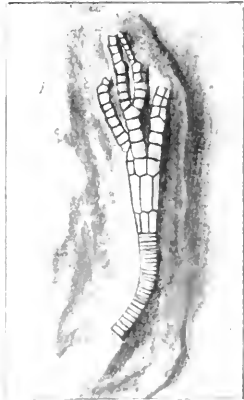
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2

PAGECRINUS, A NEW CRINOID GENUS

FOR EXPLANATION OF PLATE SEE PAGE 4



# A NEW SPECIES OF MOSQUITO FROM MONTANA, WITH ANNOTATED LIST OF THE SPECIES KNOWN FROM THE STATE

By HARRISON G. DYAR

*Custodian of Lepidoptera, United States National Museum*

The discovery of a new species of mosquito in Montana is an unexpected and noteworthy event, not only because the State has been so often and so well explored for its mosquito fauna but because the species hitherto found have all an extended range outside of the State. That the present new species is confined to Montana is hardly to be expected, yet it has so far eluded intensive collecting elsewhere.

This discovery is due to the skill of G. Allen Mail, acting for the Bozeman Experiment Station under the direction of W. B. Mabey, extension entomologist. Mr. Mail formerly acted as assistant to Eric Hearle, the Canadian mosquito expert, during the campaign at Banff which was so satisfactorily carried out from the viewpoint of the visiting tourist.

## **ÆDES SCHIZOPINAX, new species**

*Female*.—Proboscis rather long, slender, uniform, black. Palpi short, about one-eighth the length of the proboscis, black. Occiput with bronzy brown narrow curved scales. Mesonotum with bronzy-brown scales; two broad darker brown bands are faintly relieved, lighter edged outwardly posteriorly, separated by a very narrow median bare line; posteriorly the scales and hairs are lighter, with a faint whitish tint. Abdomen black, with broad basal segmental sordid white bands, the last two segments very largely whitish; venter whitish scaled, with more or less developed median black dashes. Legs black, the femora pale beneath. Wing scales hairlike, all dark. A rather small species, about the size of *cataphylla*.

*Male*.—Palpi as long as the proboscis, the last joint slightly club-shaped, the penultimate joint with long hairs, black. General coloration as in the female, the vestiture of the mesonotum slightly more sparse and open. Hypopygium: Sidepiece slender, uniform, about three times as long as wide; apical lobe distinct, narrow, conical, with rather few fine, short, curved hairs; basal lobe broadly expanded, thin, dotted with tubercles bearing fine short setae; on the inner angle a slightly rounded prominence bears several long setae, the

in a rather shallow canyon in which are grassy spots surrounded by willows.

**AÈDES COMMUNIS** DeGeer

Very abundant in the forests of Glacier National Park both in 1921 and 1926. The adults are very variable in size and ornamentation. I have examined bred specimens from Chestnut May 2, 1928, and Squaw Creek, May 6, 1928, both collections made by G. Allen Mail.

**AÈDES PIONIPS** Dyar

Occasional in the forests of the Glacier National Park.<sup>7</sup> I also received specimens from W. B. Mabce collected on June 28, 1916, at Bozeman, Gallatin County, in a very shallow pool in a clover field where clover leaves practically covered the pool. The field is near the center of Gallatin Valley, some 4 or 5 miles from the nearest mountains. This is very unusual occurrence for the species (1388).

**AÈDES CATAPHYLLA** Dyar

In the Glacier National Park in 1926 the "graybacks" were the first mosquito on the wing, but not in large numbers. Larvae had practically all passed at the time of my arrival and the adults disappeared soon also. The breeding places seem to be in the edges of large marsh pools. Worn females were found around the edges of one such, where they had evidently been ovipositing. The central part of these pools are permanent, but the edges go dry for long distances. G. Allen Mail bred a culture from Bridger Canyon, May 1, 1928, where they were associated with *Aedes increpitus mutatus* Dyar.

**AÈDES IMPIGER** Walker

This occurred in the Glacier Park with *Aedes cataphylla*, the larvae having all passed by April 15, 1926; but a few undoubted adults were taken on the wing. Mr. Mabce transmitted bred specimens, but I have not the exact data before me (473).

**AÈDES NEARCTICUS** Dyar

This is the "little black mosquito" frequenting all the higher passes of the Glacier Park in midsummer. In 1926 Park Ranger Paul Schoenberger went to the head of Swifteurrent Pass and to the foot of the Grinnell Glacier for me and found this species breeding in large numbers together with *communis* and *pullatus*. The altitude is only about 5,300 feet, but the presence of the ice cools the region. Eric Hearle, at Banff, did not find this species breeding below 6,000 feet. As with the Californian high altitude form, *Aedes ventrovittis* Dyar, the distribution appears to be upward, as found by Professor Freeborne.<sup>8</sup>

<sup>7</sup> Ins. Ins. Mens., vol. 10, p. 85, 1922.

<sup>8</sup> Univ. of Calif. Pub's., Tech. Bull. Coll. Agr., Agr. Exper. Station, vol. 3, p. 378, 1926. The females are not found biting in the forest.

**AÈDES DIANTAEUS** Howard, Dyar, and Knab

Adults were taken by me in 1921 and larvae in several of the early spring pools in 1926 in the Glacier Park. Some bred adults were indistinguishable in coloration from *communis*, although the normal form also occurs in the park. I have no other Montana records.

**AÈDES INTRUDENS** Dyar

Breeding in the Glacier Park with *diantaeus*, the larvae fully as rare in 1926. Owing to the habit of the adult of entering houses, specimens of this species were taken almost every day to the middle of July in the cabin of the North Fork Ranger Station, although apparently passed out of doors. Mr. Mabec submitted specimens bred at Darby, May 30, 1928, by Mrs. Dr. R. R. Parker from a shaded pool in woods. Adults issued on June 3.

**AÈDES PULLATUS** Coquillett

Breeding in the early spring pools at higher elevations in the Glacier Park, but always a late inhabitant of them, the larvae lingering after the *communis* and *nearcticus* had long emerged. Mr. Mabec submitted specimens as follows: Chestnut, May 2, 1928 (G. Allen Mail); Karse, W. Gallatin, May 3, 1928 (G. Allen Mail); Squaw Creek, May 6, 1928 (G. Allen Mail); West Gallatin, May 24, 1928 (G. Allen Mail); Sedan, May 28, 1928 (G. Allen Mail); Ross' Peak Ranger Station, May 28, 1928 (G. Allen Mail); King's Hill, June 11, 1928 (G. Allen Mail); Darby, May 30, 1928 (Mrs. Dr. R. R. Parker).

**AÈDES TRICHURUS** Dyar

This species was common in the North Fork ranger station of the Glacier National Park in the 1926 season. The station is on a high, dry bank, 100 feet above the Flathead River, and no mosquito breeding occurs in the vicinity. However, some 2 miles back at the foot of the Apgar Mountains a large marsh occurs. There is also a similar marsh across the river, outside of the park, near Lake Five. This also is about 2 miles from the station in a straight line. *Aedes trichurus* from these two foci, but especially from the latter, were numerous, being the commonest mosquito at the station. Great swarms of males were seen, first noted a mile from the Lake Five marsh. The swarms broke up, crossed the river, and could be found here and there in the forest in the park for several days. They swarmed shortly before sunset, dispersing at dark. The females bit at all times, day and night, though their approach was timid, and they were easily driven away.

**AÈDES EXCRUCIANS** Walker

This was the common ring-legged mosquito in the Glacier Park in 1926. Great numbers emerged from the marsh at the foot of the Apgar Mountains near the North Fork station. Females were flying till August. Mr. Mabec submitted specimens labeled "Central Park (flood water), June 5, 1928 (G. Allen Mail)."

**CULICELLA IMPATIENS** Walker

In the Glacier Park in 1926 overwintering adults were quite fond of entering the cabin in early spring, in company with *Anopheles maculipennis*. None were thus seen after June, and later larvae began to be found in cold spring pools after the snow water and river floods had wholly passed. Adults were very common at dusk at Many Glacier on the still evening of June 2. A still evening is rare at that spot, however. Mr. Mabee submitted specimens from Hamilton June 3, 1928 (Mrs. Dr. R. R. Parker).

**CULICELLA INCIDENS** Thomson

Not found in the Glacier Park in 1921, although it occurred in several isolated spots in 1926. The larvae inhabit late pools of a generally permanent character. They occurred in an old barrel partly filled with water at the North Fork station. Mr. Mabee submitted specimens from Hamilton June 3, 1928 (Mrs. Dr. R. R. Parker).

**CULICELLA INORNATA** Williston

Very frequent in warmer regions in the summer time, breeding in stagnant pools. Larvae were found abundantly in a water tank at Kalispell in 1926. Mr. Mabee has submitted specimens from the following localities: Three Forks, July 18, 1928 (G. Allen Mail); Skalkaho Canyon, June 3, 1928 (Mrs. Dr. R. R. Parker); Hamilton, July 6, 1928 (Mrs. Dr. R. R. Parker).

**CULICELLA ALASKAENSIS** Ludlow

Not hitherto recorded from the State. Mr. Mabee submitted a specimen from near Squaw Creek ranger station at about 6,000 feet altitude May 6, 1928 (G. Allen Mail).

**CULEX TARSA LIS** Cequillett

Very common in the summer time in the warmer parts of the State, breeding with *Culicella inornata*. Mr. Mabee submitted specimens from the following localities: Skalkaho Canyon, June 3, 1928 (Mrs. Dr. R. R. Parker); Hamilton, June 3, 1928 (Mrs. Dr. R. R. Parker).

**CULEX APICALIS** Adams

The larvae were common in late summer in the Glacier Park in 1926 in all the cold spring pools. As this species does not bite warm-blooded animals, the adults are always inconspicuous and encountered only by beating.

**ANOPHELES MACULIPENNIS** Meigen

The "malaria mosquito" was rather common on the west side of the Glacier Park in 1926, hibernating adults entering the cabin in early spring. Larvae were found in the warmer algae-filled pools along the larger lakes and marshes. Mr. Mabee submitted bred specimens from Victor July 12, 1918 (R. R. Parker).

# TERTIARY FOSSIL PLANTS FROM COLOMBIA, SOUTH AMERICA

By EDWARD W. BERRY

*Of Johns Hopkins University, Baltimore, Md.*

In a paper published in 1913 Father Miguel Gutiérrez<sup>1</sup> mentions trunks and impressions of dicotyledonous leaves associated with the coal seams at Guadalupe, but his conjectures regarding their probable identity are unreliable and his illustrations are unrecognizable. Aside from this paper I know of no publications on the Tertiary flora of Colombia other than those of Engelhardt and the present writer.

In 1895 Engelhardt<sup>2</sup> described 35 species of plants from the tuffs of Santa Ana in the upper Magdalena Valley, and 5 species from Buga in the Cauca Valley which he referred to the Tertiary. Several of these have been found in deposits of known Miocene age in Venezuela, Peru, southern Mexico, and Costa Rica, which would seem to indicate a Miocene age for these Colombian plants described by Engelhardt.

My contributions to Colombian paleobotany comprise the following descriptions of fruits and seeds: A *Simaruba* stone from Guasca; *Saccoglottis* stones from Cipacon and drupes of *Cordia* from Guasca, described in 1924;<sup>3</sup> *Anacardium* fruits from Santo Ecce Homo, Boyacá;<sup>4</sup> *Celtis* stones from Pijiaquay;<sup>5</sup> *Vantanea* stones from Cipacon and a second species of *Anacardium* from Ovejas;<sup>6</sup> and seeds of *Musa* from Guadalupe and Montserrat.<sup>7</sup>

A miscellaneous amount of leaf impressions and unrecognized carpological material has been awaiting study for several years, and it is the purpose of the present paper to place this material on record. For this material I am indebted to Maurice A. Rollot of Bogota, W. P. Woodring, and Robert Anderson. In a region so little known geologically it is impossible to be certain of the precise horizon of much of the material. This is especially true of the continental deposits, and too little is known of the fossil floras of tropical America for the plants themselves to afford accurate chronological

<sup>1</sup> Gutiérrez, M., *Geología de Bogotá y sus alrededores*, *Anales de Ingeniería*, vol. 20, pp. 313-331, 1913.

<sup>2</sup> Engelhardt, H., *Abh. Senck. naturf. Gesell.*, vol. 19, pp. 24-41, 1895.

<sup>3</sup> *Bull. Torrey Bot. Club*, vol. 51, pp. 61-67, figs. 1-22, 1924.

<sup>4</sup> *Amer. Journ. Sci.*, vol. 8, pp. 123-126, 1924.

<sup>5</sup> *Torrey*, vol. 24, pp. 44-46, 1924.

<sup>6</sup> *Pan Amer. Geol.*, vol. 42, pp. 259-262, 1924.

<sup>7</sup> *Amer. Journ. Sci.*, vol. 10, pp. 530-537, 1925.

information. Large collections remain to be made, and eventually we may expect that the present lack of information will be remedied.

The present communication enumerates 16 species, of which 11 are new. Six are of carpological material and 10 are based upon leaves. Fifteen genera, 14 families, and 12 orders are represented. Especially interesting is a fragment of a *Zamia* pinnule, a fruit of a *Lepidocaryum*-like palm, a representative of the South American bamboos, and the fruit of *Theobroma* (cacao). Some of the material is precisely located both geographically and geologically and some is not, so that no ecological or chronological comments are warranted.

## Order CYCADALES

### Family CYCADACEAE

#### Genus *ZAMIA* Linnaeus

##### *ZAMIA* species

##### Plate 1, Figure 6

The single fragment upon which this identification is based is worthless from a specific standpoint, but of considerable interest as it appears to represent a pinnule of a *Zamia*. It indicates a fairly large, linear-lanceolate coriaceous pinnule, contracted toward the base, and with 12 or 13 stout parallel veins. The specimen comes from sandstone associated with the coal at Montserrate near Bogota.

*Zamia* with about 35 existing species is the dominant cycad genus of the Western Hemisphere, ranging from peninsular Florida and Mexico through the Antilles and Central America to eastern Bolivia and northern Argentina. Tertiary species have been found from latitude 36° 30' north to 41° 30' south and include 3 from the lower Eocene of southeastern North America, 2 from the Tertiary of Porto Rico, 1 from the Miocene of Chile, and 1 from the Oligocene (?) of Patagonia.

## Order POALES

### Family POACEAE

#### Tribe BAMBUSEAE

#### Genus *CHUSQUEA*

##### *CHUSQUEA* ROLLOTTI, new species

##### Plate 2

Large grass with relatively slender stems, large linear-lanceolate leaves, and expanded rhizomal internodes. The material is abundant but fragmentary and can be but incompletely described.

The leaves are of a considerable degree of consistency, narrowed to the sessile and slightly inequilateral base, with stout midveins and slender parallel lateral veins; they vary in maximum width from



less than 1 to over 2.5 centimeters; lengths of as much as 16 centimeters are preserved with the margins practically parallel, but in no cases are the tips preserved and these were presumably acuminate. The stems are longitudinally striated. There are several crushed internodes of rhizomes in the collection. In no case are these complete. All are flattened but are of considerable consistency; these internodes are about 6 to 7 centimeters in length, and 2.5 to 3.5 centimeters in diameter in their present condition; they show no details except the somewhat distorted thin vascular strands of the cortex. Named for the collector Dr. Maurice A. Rollot.

So far as I know this is the first published record of the occurrence of *Chusquea* as a fossil, although I have observed similar remains, probably of this genus, at a number of localities in Peru and Bolivia, and they are comparatively common in the tufaceous deposits of late Tertiary to Recent Age which are so widespread in the Andean region.

The present species occurs in a well-lithified gray shale associated with the coals of Usme and I am informed is the horizon known locally as the Piso Barzalosa. It is overlain by gypsiferous varicolored shales and underlain by black shales, and is said to be older than the coal-bearing beds of the Sabana of Bogota. The locality is La Virginia on the railroad about 15 kilometers from Girardot, Dept. of Cundinamarca.

The genus *Chusquea* has about 50 existing species, ranging from Mexico to southern Chile, and it is especially characteristic of the east Andean Ceja region, denoting an abundant water supply. Its present-day altitudinal limit under the equator is around 11,500 feet.

## Order ARECALES

### Family PALMAE

#### Subfamily LEPIDOCARYINAE

#### LEPIDOCARYOPSIS, new genus

#### LEPIDOCARYOPSIS ROLLOTI, new species

#### Plate 1, Figure 7

The single incomplete specimen upon which this species is based was sent to me by Dr. Maurice Rollot of Bogota along with other carpological material collected from the so-called Guaduas formation of that region, but I do not know the exact locality where the specimen was obtained. It is a cast in a fine-grained sandstone matrix and indicates a fruit prolate spheroidal in form, more narrowed toward the base than toward the apex, about 5 centimeters in diameter, covered with what were in life coriaceous scales, arranged in a low spiral. These scales are rhomboidal in shape, about a centimeter in width, bluntly pointed and overlapping (imbricated) in the direction of the base.

The species is named for the collector. There can be no doubt but that the fossil represents a nut of some Tertiary palm belonging to the subfamily Lepidocaryinae, but since the genus can not be ascertained I have coined the generic term *Lepidocaryopsis* for its reception. The reasons for uncertainty regarding the precise generic affinity of the fossil are the incomplete character of the type, the lack of generic differences in the fruits of the existing genera and the lack of sufficient recent comparative material. It may well be that the fossil belongs to one or the other of the three American tropical genera *Mauritia*, *Lepidocaryum*, and *Raphia*; in fact I regard this as very probable.

The genus *Mauritia* is confined to tropical South America with about 10 existing species; the genus *Lepidocaryum* has 5 or 6 Amazonian species and the genus *Raphia* has about 6 existing species ranging from Central America to Brazil and also represented in Africa. From the point of view of the existing distribution *Raphia* should be the oldest of the three and the fossil may well represent that genus, with which it agrees in so far as its features can be made out.

## Order URTICALES

### Family MORACEAE

#### Genus COUSSAPOA Aublet

#### COUSSAPOA AMPLA, new species

#### Plate 3

Leaves of large size, widest below the middle, with a bluntly pointed tip and a broadly truncated and slightly decurrent base. Margins entire. Texture coriaceous. Length about 19 centimeters. Maximum width about 15.5 centimeters. Petiole short and stout; in the single specimen in which this part is preserved it is only about 1 centimeter in length. Midvein exceedingly stout and prominent. Secondaries numerous, stout, and prominent; they diverge from the midvein at angles around  $45^\circ$ , pursue rather straight subparallel courses, and are abruptly camptodrome close to the margins. The secondaries are rather evenly spaced, except at the base, where two or three pairs are convergent near the top of the petiole. The imperfection of the material in the marginal region renders it impossible to state whether the secondaries send off lateral branches or not. Tertiaries faint, numerous, and percurrent. Areolation obsolete.

This fine species is unfortunately represented by an inadequate amount of broken material. It was collected by Maurice A. Rollet from the outcrop of coal-bearing Tertiary at the Falls of Tequendama, west of Bogota, and is probably Oligocene in age. If this is the correct age it is the oldest as well as one of the largest fossil species of *Coussapoa* known. It differs sufficiently from the known species to be readily recognizable, and hence obviates the necessity of contrasting the differences in the present connection. Several fossil

species of *Coussapoa* have been described in recent years from tropical America. These comprise forms from the Miocene of southern Mexico,<sup>8</sup> Venezuela,<sup>9</sup> Trinidad,<sup>10</sup> Ecuador, and Bolivia.<sup>11</sup>

The genus contains about 15 existing species of shrubs and trees confined to the rain forest country between southern Mexico and Brazil and the Bolivian Yungas.

**COUSSAPOA GIGANTEA, new species**

Plate 4

Leaves of large size, broadly ovate in outline, abruptly acute tipped, broadly cuneate or rounded at the base. Margins entire. Texture subcoriaceous. Length at least 25 centimeters. Maximum width, at or below the middle, 19 to 20 centimeters. Midvein extraordinarily stout and prominent. Secondaries stout and prominent, seven or eight pairs; they diverge from the midvein at wide angles proximad, becoming more ascending in the upper half of the leaf, curving regularly and camptodrome close to the margins. Tertiaries relatively very thin, closely spaced, parallel, and percurrent. Areolation obscure.

This species is based upon the single incomplete specimen figured. It is preserved in a sandstone and the finer features are consequently obscure. It unquestionably belongs to some member of the family Moraceae, and among these is more like the leaves of the genus *Coussapoa* than any other known to me, although it does not agree exactly with all the features of any existing species.

I am indebted to Robert Anderson for the specimen, which was found as float in the northwestern outskirts of Cali a few hundred feet north of Rio Cali at the edge of the Cauca Valley. It obviously had fallen from one of the thick, hard sandstone beds which are here interbedded with carbonaceous clays and sands. It is possibly of the same age as the Tertiary plants described by Engelhardt from Buga in the Cauca Valley.

## Order ROSALES

### Family MIMOSACEAE

#### Genus INGA Willdenow

#### INGA REISSI Engelhardt

Plate 5, Figure 1

*Inga reissi* ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 36, pl. 8, figs. 1, 2; pl. 9, fig. 8, 1895.

This species, described by Engelhardt from rather abundant material from Santa Ana, Colombia, appears to be present in the older travertine near Leiva, Department of Bayaca.

<sup>8</sup> Berry, E. W., Proc. U. S. Nat. Mus., vol. 62, art. 19, p. 6, pl. 2, 1923.

<sup>9</sup> Berry, E. W., Idem, vol. 59, p. 563, fig. 2, pl. 108, figs. 1-4, 1921.

<sup>10</sup> Hollick, A., Bull. New York Bot. Gard., vol. 12, p. 296, pl. 6, fig. 1, 1924.

<sup>11</sup> Berry, E. W., Johns Hopkins University Studies in Geology, No. 4, p. 168, pls. 4, 5, 1922.

## Family CAESALPINIACEAE

## Genus CYNOMETRA Linnaeus

## CYNOMETRA MCGILLI, new species

Plate 1, Figures 8, 9

Pod rather small, inflated, tardily dehiscent. About half as wide and thick as long, uniformly rounded at both ends. Peduncle scar excentric toward the placental side, which is somewhat flattened and nearly straight; opposite side full and broadly curved in both lateral and terminal profiles. Valves very thick and leathery. Surface prominently corrugated by irregularly impressed grooves bounding rounded more or less warty ridges. Length, 2.7 centimeters; width, 1.3 centimeters; thickness, 1.4 centimeters. Named for the collector A. K. McGill.

This species is based upon the single valve figured. The only recent form which approaches it closely is the genus *Cynometra*, which comprises about 30 species of shrubs and trees found in all tropical lands. The recent specimens I have seen are drift material from San Miguel Bay in which the pods are about the same size but are considerably wider and the surface rugosities follow a somewhat different pattern from that of the fossil. All of the modern species have small leathery pods with thick, papillose ridged walls.

The fossil species is lower Miocene in age, and comes from Quebrada Pajuil west of Rio Sinu, Department of Bolivar, Colombia.

## Order GERANIALES

## Family HUMIRIACEAE

## Genus SACCOGLOTTIS Martius

## SACCOGLOTTIS CIPACONENSIS Berry

Plate 1, Figures 1-5

*Saccoglottis cipaconensis* BERRY, Bull. Torrey Bot. Club, vol. 51, p. 64, figs 20-22, 1924.

This species was based upon four specimens from the Guaduas formation at Cipacon, Department of Cundinamarca, and I have since received a large amount of material from the type locality.

The silicified fruits of *Saccoglottis* from Belen, Peru, which I referred to this species, I would now separate as they are prevailing 5-seeded whereas in the Cipacon material of 46 specimens 4 are 5-seeded, 33 are 6-seeded, 6 are 7-seeded, and 3 are 8-seeded.

There is no need to repeat the description of this form but several illustrations from photographs are given to show the range in size and form.

## Order SAPINDALES

### Family SAPINDACEAE

#### Genus SAPINDOIDES Perkins

##### SAPINDOIDES PERUVIANUS Berry

Plate 1, Figure 10

*Sapindoides peruvianus* BERRY, Pan Amer. Geol., vol. 47, p. 126, pl. 19, fig. 9, 1927.

This determination is based upon the single specimen figured, which appears to be identical with the type. It is especially interesting in having been collected from middle Eocene marine beds in Colombia. It was described originally from Belen in northwestern Peru and has also been recorded from the Ancon Point sandstone of western Ecuador. If I have been correct in identifying this species at these three widely scattered early Tertiary localities, these occurrences have a considerable value for purposes of correlation and also in their bearing upon environmental conditions.

*Occurrence*.—Middle Eocene. Arroyo 1½ miles east of Tolu Viejo on trail to Colodo, Department of Bolivar. Collected by A. Iddings and F. A. Sutton.

## Order RHAMNALES

### Family RHAMNACEAE

#### Genus GOUIANA Linnaeus

##### GOUIANA LEIVANA, new species

Plate 5, Figure 2

Leaves ovate-cordate, small, with a sharply but shortly pointed tip and an equilateral cordate base. Margins entire below, above with large and somewhat variable crenate teeth. Textures subcoriaceous. Length about 5.5 centimeters. Maximum width, about midway between the apex and the base, about 4 centimeters. Petiole not preserved. Midvein stout, prominent. A pair of stout lateral primaries diverge from the base of the midvein at angles of about 45° and sweep upward in broad even curves about two-thirds of the distance to the tip, where they join the lower secondaries. Secondaries relatively thin; about four camptodrome pairs in the upper half of the leaf; also as regularly spaced camptodrome outer branches from the lateral primaries. Tertiaries thin. Areolation indistinct.

This species bears considerable resemblance to part of the material from the tuffs of Santa Ana which Engelhardt included in his *Gouiana firma*.<sup>12</sup> The material has been compared especially with recent

<sup>12</sup> Engelhardt, II., Abh. Senck. Naturf. Gesell., vol. 19, p. 34, pl. 4, figs. 6, 7, 1895.

tropical American forms of various Sterculiaceae, *Triumfetta* (Tiliaceae) and Ulmaceae. There is considerable resemblance to certain species of *Momisia* in the last family, but the equilateral cordate base favors its reference to *Gouiana* in which a number of species, both in the new and old worlds, are very similar.

The fossil material comes from the older travertine at Leiva, Department of Boyaca.

The genus contains about two score species of herbs and climbing shrubs found in all the Tropics and occasionally in the sub-Tropics. Over half of the existing species are confined to northern South America. Several Tertiary species have also been described from the latter region.

## Order MALVALES

### Family STERCULIACEAE

#### Genus THEOBROMA Linnaeus

#### THEOBROMA FOSSILIUM, new species

Plate 1, Figures 13, 14

This is based upon a single specimen, which shows in natural section a nearly complete transverse and part of a tangential section of the fruit. The axis and thick walls as well as the seed coats have been replaced by calcium carbonate and the matrix and interstices between the seeds consist of a dark calcareous mudstone. The whole fruit is about 5 centimeters in diameter and oval instead of circular in cross section because of the abortion of the ovules in three of the cavities. The wall is ligneous and about 6 millimeters in thickness, with a rough surface, but not appreciably ribbed or tuberculated. There are five cells, but seeds are matured in but two of these. The matured seeds are large and are oriented either horizontally or obliquely, and more or less radially to the axis. They are rounded at both ends and elliptical in cross section, the maximum equatorial diameter being about 10 millimeters and the minimum about 8 millimeters. The length is about 2 centimeters. The outer seed coat appears to have been smooth and is about 1 millimeter in thickness. The inner seed coat is prominently longitudinally striated.

The specimen is unfortunately incomplete. It was collected by Dr. Maurice A. Rollet at a locality called El Infierno, near Leiva, in the Department of Boyaca.

The geological age of the specimen is very uncertain. The country rock around the Leiva Valley is Cretaceous limestone (Hettner's Villeta beds) overlain by his Guaduas beds, here supposed to be of lacustrine origin. There are thermal springs near Leiva and travertine deposits, both ancient and modern. I have plants from both, but the lithology of the *Theobroma* matrix differs from both of these and

suggests that it may come from the Guaduas beds, but it would take a personal examination to settle the question and the age must therefore be considered conjectural.

The accompanying figures show both the transverse and tangential sections with the plant parts in white and the matrix and filling in black.

The genus *Theobroma* comprises about a dozen existing species of trees confined to the American Tropics, where they range from the warmer parts of Mexico to the upper Amazon. All are humid tropical types and the cultivated forms have been introduced into all tropical lands. This appears to be the first record of a fossil form, and it is particularly unfortunate that more material is not available and that the age can not be settled.

## Order LAURALES

### Family LAURACEAE

#### Genus PERSEA Gaertner filis

#### PERSEA CORIACEA Engelhardt (?)

Plate 5, Figure 3

*Persea coriacea* ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 26, pl. 6, figs. 3, 4, 1895

Since the present material is very fragmentary certainty of identification is impossible, but the material is certainly lauraceous and appears to represent the species described by Engelhardt from Santa Ana, Colombia, as a *Persea*. There is much difficulty in discriminating fossil leaves of this family and similar leaves have also been referred to *Nectandra*, *Mespilodaphne*, and *Oreodaphne*. Hollick has recently referred similar leaves from the Tertiary of Porto Rico to the related genus *Aniba*.

Because of the incompleteness of the present material close comparisons are impossible and for the same reason there is no advantage in changing the genus to some other equally uncertain one, and the species is therefore retained as it was designated by Engelhardt. It comes from the older travertine at Leiva, Department of Boyaca.

#### Genus NECTANDRA Roland

#### NECTANDRA AREOLATA Engelhardt

*Nectandra areolata* ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 29, pl. 6, figs. 1, 2, 1895.—BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 177, pl. 27, 1921; vol. 62, art. 19, p. 19, pl. 4, fig. 3, 1923.

This species was described by Engelhardt from Santa Ana, Colombia, and recorded by me from the Miocene of Costa Rica and southern Mexico (Oaxaca).

Matted leaves that appear to represent the same species are present in the roofing shales of the coal near the Falls of Tequendama.

## Order EBENALES

### Family SAPOTACEAE

#### Genus *CHRYSOPHYLLUM* Linnaeus

##### *CHRYSOPHYLLUM ROLLOTI*, new species

Plate 5, Figure 5

Leaf elongate, ovate-lanceolate in outline, with a gradually narrowed acuminate tip. Texture somewhat coriaceous. The entire margins are somewhat irregular or undulate. Midvein stout, prominent. Secondaries thin, closely spaced, subparallel, and camptodrome; they diverge from the midvein at wide angles and curve sharply upward near the margins. Tertiaries obscure. Length (estimated) about 14 centimeters. Maximum width about 5.25 centimeters.

Although based upon incomplete material, the character of the venation stamps it as a *Chrysophyllum*. It is very similar to *Chrysophyllum ficifolia* Berry<sup>13</sup> of the lower Eocene (Wilcox) of southeastern North America, and there are several recent species in northern South America and the Antilles with very similar leaves.

The genus is tropical and subtropical with about 60 existing species, which are largely American, although the genus is sparingly represented in all the other tropics. Several fossil species have been described.

The present species comes from the older travertine at Leiva, Department of Boyaca.

## Order RUBIALES

### Family RUBIACEAE

#### Genus *SABICEA* Aublet

##### *SABICEA ASPERIFOLIA LANCEOLATA*, new variety

Plate 5, Figure 4

After an extended comparison I have decided to describe this well-marked leaf as a variety of the species of *Sabicea* described by Engelhardt<sup>14</sup> from the Tertiary at Buga in the Cauca Valley of Colombia.

Leaf lanceolate, widest at or slightly below the middle and tapering equally to the acuminate tip and to the acute slightly decurrent

<sup>13</sup> Berry, Edward W., U. S. Geol. Survey, Prof. Paper 91, p. 335, pl. 100, fig. 7, 1916.

<sup>14</sup> Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 40, pl. 5, fig. 6; pl. 8, fig. 6, 1895.



base. Margins entire, sometimes slightly undulate. Texture subcoriaceous. Length about 10 centimeters. Maximum width 2.25 to 3.5 centimeters. Petiole very short and stout, expanded at the base. Midvein stout and prominent. Secondaries relatively thin, numerous, subparallel, diminishing in repeated flat archings in the marginal region which their distal ends parallel; their angle of divergence from the midvein is acute in the narrower leaves and obtuse in the wider leaves. Distal tertiaries precurrent, proximal occasionally anastomosing or crossed by tertiaries from the midvein and parallel with the secondaries.

I have compared the fossil with a variety of recent leaves, some few of which are worth mentioning. In the genus *Pilocarpus* the lanceolate forms of *Pilocarpus racemosus* Vahl, an Antillean and Central American species are much like the fossil, but there are minor differences in venation and the majority of leaves of *Pilocarpus*, even of the species mentioned, are different in form. I have also found leaves of *Rhabdodendron amazonicum* (Sprengel) Huber (Rutaceae) which were similar, but this species tends to have larger leaves which are frequently obovate or even emarginate, and all of the recent forms have prevalingly larger leaves. I have seen a few recent leaves from Colombia belonging to the genus *Quiina* Aublet somewhat similar to the fossil, but the majority show decided differences, and the same remark applies to the genus *Maytenus* in which the leaves are frequently toothed and the venation different, but in which *Maytenus myrsinoides* Riess approaches the fossil. The same is true of the genus *Casearia* Jacquin (Samydaceae) where the leaves are mostly toothed. Engelhardt compared the Buga fossil with the existing *Sabicea aspera* Aublet—a composite which has since been made the basis of several species, and the type of which is not especially close to the fossil. Most of the existing species of *Sabicea*, which are about 35 in number and include both shrubs and climbers, have relatively slightly shorter and wider leaves which are conspicuously hirsute, pilose, or canescent. They are largely American but occur also in the African tropics. The most similar one seen is *Sabicea glabrescens* Benthham of northern South America in which the variation in form is matched among the several fossil specimens. The latter come from the older travertine at SÁCHICA near Leiva, Department of Boyaca.

#### INCERTAE SEDIS

#### CARPOLITHUS BOLIVARENSIS, new species

Plate 1, Figures 11, 12

I am unable at present to suggest the botanical affinity of this specimen, although it is sufficiently characteristic to be readily recognized if it should turn up in future collections, or be encountered in existing carpolithological material.

It appears to represent a seed with an indurated outer coat. It is almost perfectly fusiform in shape except for a slight flattening of the sides which give it a trigonal cross section. Ends about equally bluntly pointed. Length, 2.25 centimeters; maximum diameter, in the middle, about 8.5 millimeters. No structural details can be made out.

There is some resemblance to the seeds of the Sapindaceous genus *Talisia* Aublet, but this is not especially marked and probably without significance. I have no doubt but that with more extensive comparative material its relationship could be determined.

It comes from the middle Eocene between Arroyo Mancaniajor and Ovejas, Department of Bolivar, and was collected by R. L. Bechelaymer.

#### EXPLANATION OF PLATES

##### PLATE 1

- FIGURES 1-5. Four side views and an apical view of *Saccoglottis cipaconensis* Berry.  
 6. *Zamites* species.  
 7. *Lepidocaryopsis rolloti* new species.  
 8, 9. Front and side views of *Cynometra mcgilli* new species.  
 10. *Sapindooides peruvianus* Berry.  
 11, 12. Transverse profile and side view of *Carpolithus bolivarensis*, new species.  
 13, 14. Transverse and tangential views of *Theobroma fossilium* new species. All natural size.

##### PLATE 2

- FIGURES 1-4. *Chusquea rolloti*, new species.  
 Figure 1. View showing part of a leafy branch.  $\frac{1}{2}$  natural size.  
 Figures 2-4. Rhizome joints,  $\frac{1}{2}$  natural size.

##### PLATE 3

*Coussapoa ample*, new species.  $\times 1$ .

##### PLATE 4

*Coussapoa gigantea* Berry, new species.  $\frac{1}{2}$  natural size.

##### PLATE 5

- FIGURE 1. *Inga reissi* Engelhardt.  
 2. *Gouiana leivana*, new species.  
 3. *Persca coriacea* Engelhardt (?).  
 4. *Sabicea asperifolia lanceolata*, new variety.  
 5. *Chrysophyllum rolloti*, new species.





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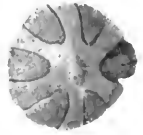
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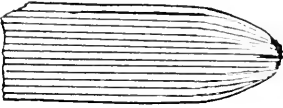
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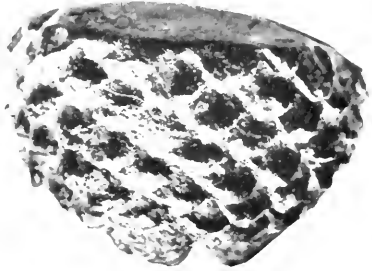
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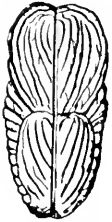
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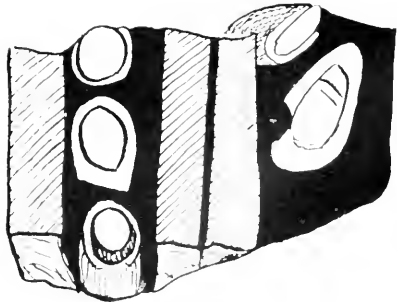
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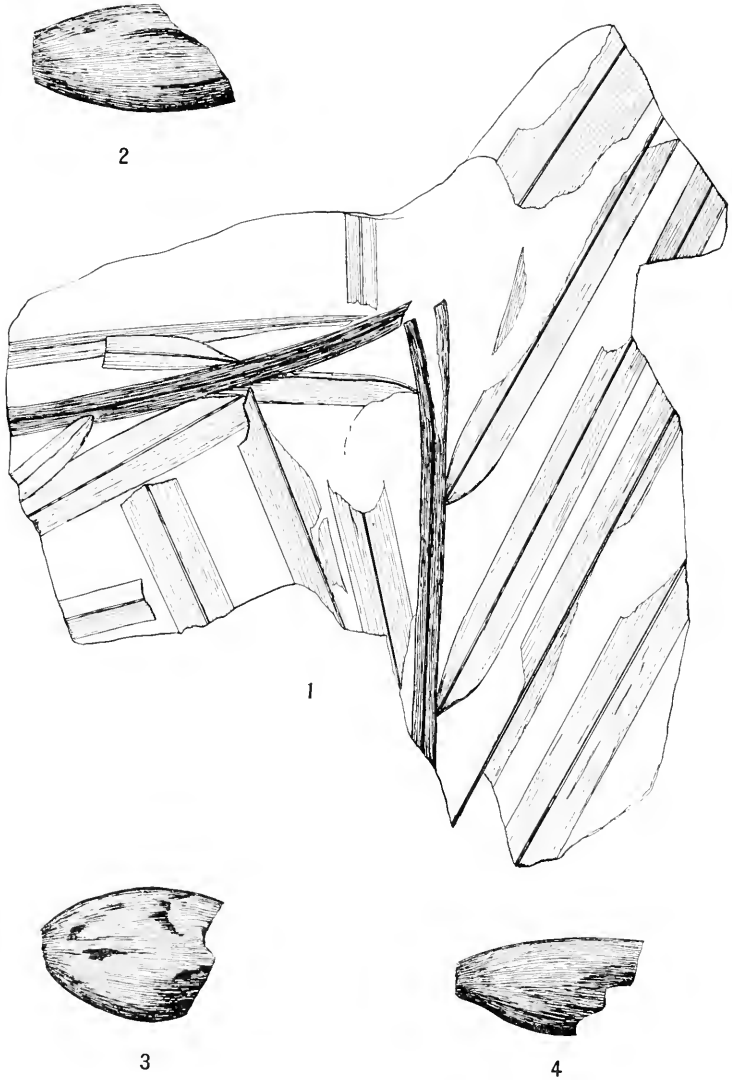
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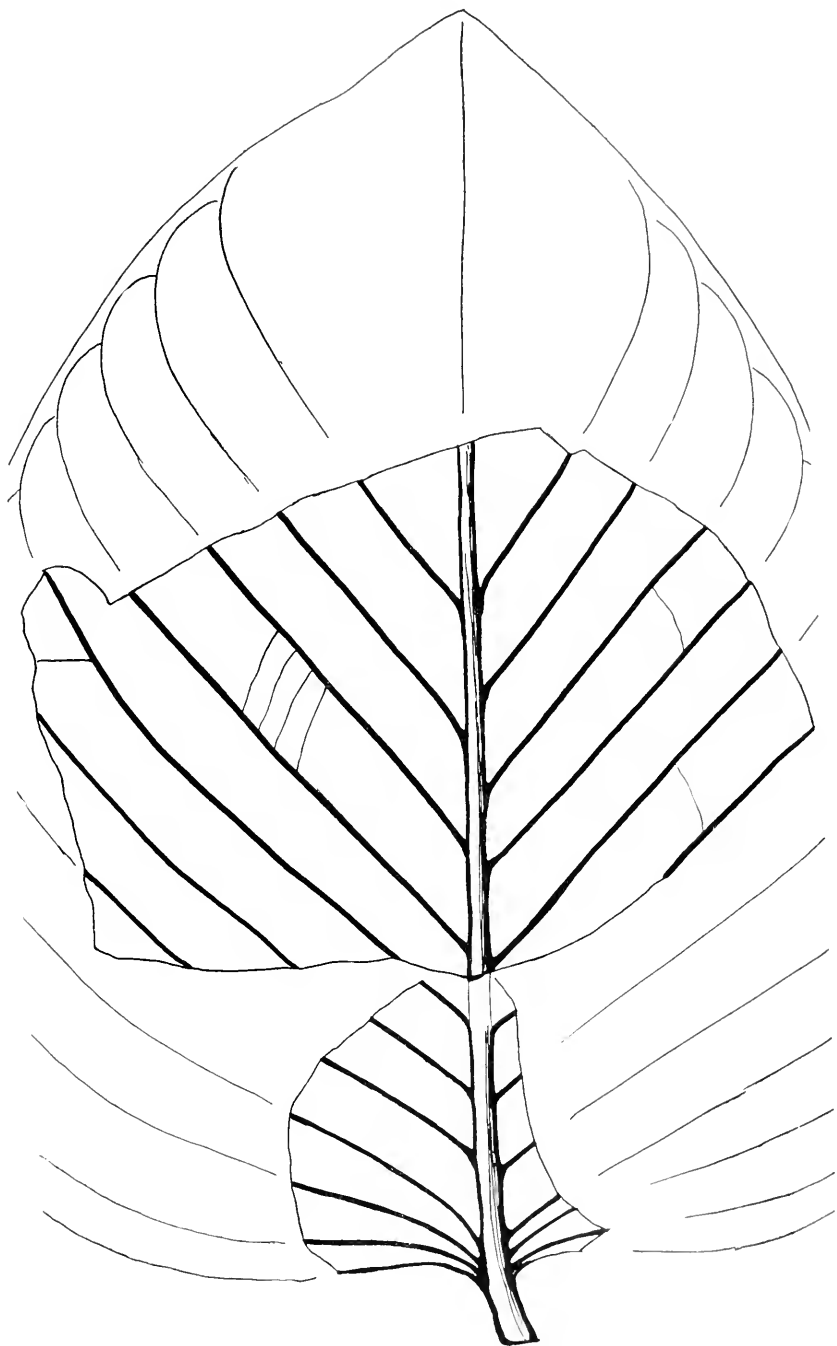
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FOR EXPLANATION OF PLATE SEE PAGE 12



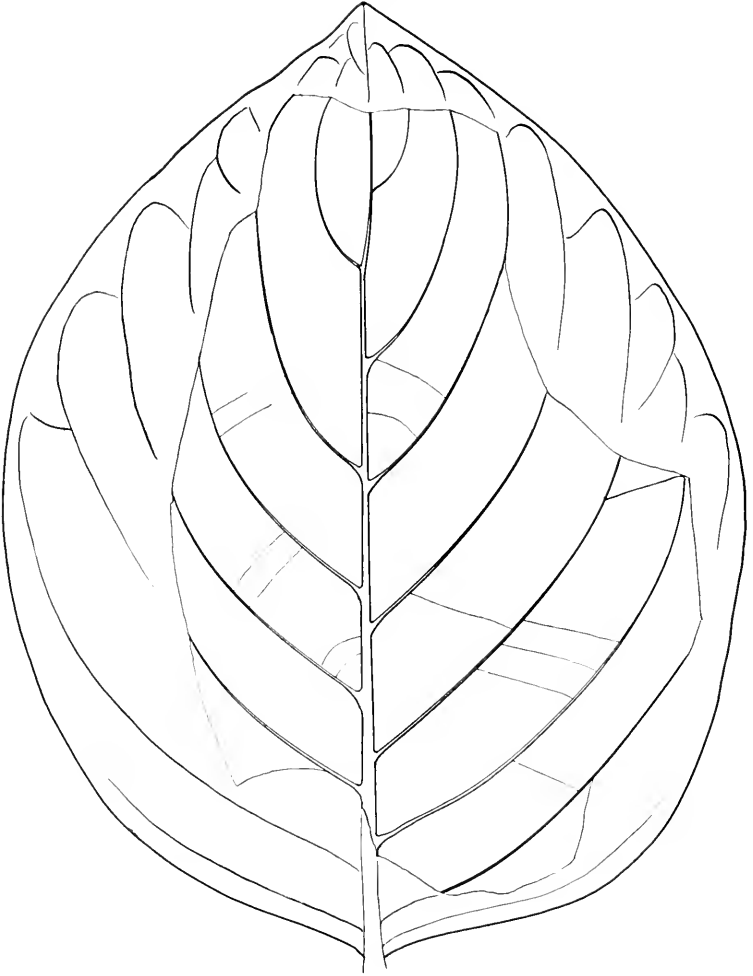
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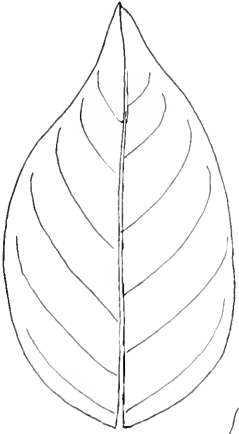
TERTIARY FOSSIL PLANTS FROM COLOMBIA

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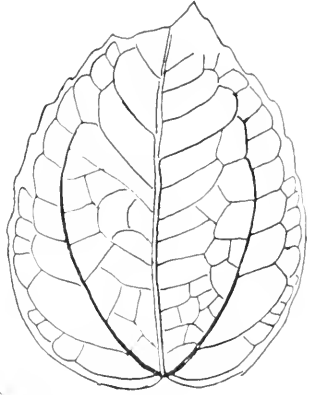


TERTIARY FOSSIL PLANTS FROM COLOMBIA

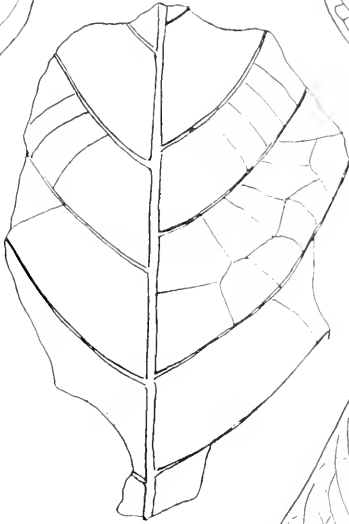
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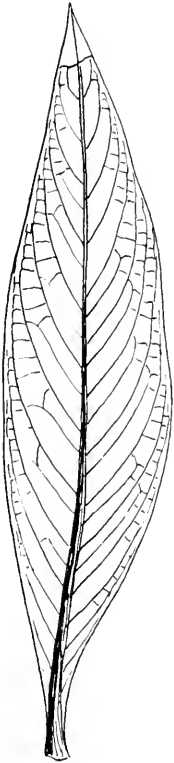
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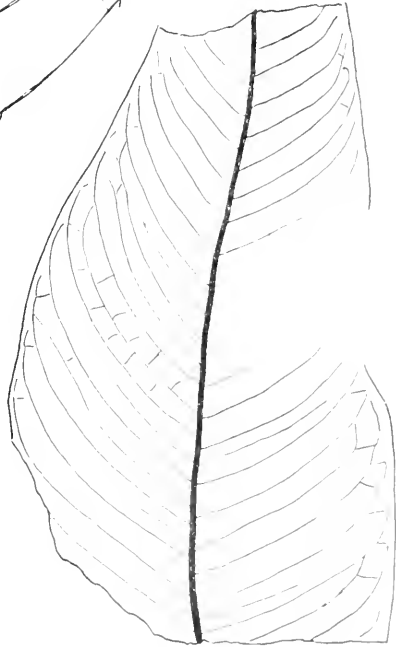
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TERTIARY FOSSIL PLANTS FROM COLOMBIA

FOR EXPLANATION OF PLATE SEE PAGE 12





# RECENT FORAMINIFERA FROM THE WEST COAST OF SOUTH AMERICA

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By JOSEPH A. CUSHMAN and BETTY KELLETT  
*Of Sharon, Mass.*

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During his recent collecting trip about South America, Dr. Waldo L. Schmitt, of the United States National Museum, as the Walter Rathbun Bacon travelling scholar of the Smithsonian Institution obtained bottom samples from numerous localities. Those from Juan Fernandez have already been studied and the results published.<sup>1</sup> The results of the study of the samples collected along the west coast of South America from Chile to Ecuador, inclusive, are given in the present paper. While the samples are not rich in number of species, nevertheless the number of specimens is often very large. Very few of the species are identical with those of Juan Fernandez, and the two faunas are very different also in the genera each contains. Along the west coast the sample from Santa Elena, Ecuador, is very distinct from those to the southward, as it contains tropical forms which are like those of the West Indian region and these do not occur in the samples from the colder waters farther to the south.

The foraminiferal fauna of the west coast of South America is very little known. In 1839, d'Orbigny published the results of his South American voyage, the Foraminifera appearing as Part 5, of the fifth volume of the *Voyage dans l'Amérique Méridionale*, with 86 pages and 9 very beautiful plates in color. It is not difficult to place most of the west coast species by consulting the figures and especially the descriptions in this work. Some of the samples collected by Doctor Schmitt are from the same locality as those from which d'Orbigny collected. Especially the rather rich collections from off Payta, Peru, have many of the older species present. Many of the d'Orbignyan species have been allowed to lapse or have been placed in the synonymy by later authors. The species from this region are really very distinctive, as one can readily see when they are studied and comparisons made with specimens from other areas.

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<sup>1</sup>Cushman and Wickenden, Proc. U. S. Nat. Mus., vol. 75, art. 9, 1929.

Except for this classic work of d'Orbigny, very little has been collected or published from this area. There are a number of records in the *Challenger* report from collections made by the *Challenger* among the islands of the southern part of the Chilean coast, but only a few of these stations were included in those studied by Brady. The United States Bureau of Fisheries steamer *Albatross* in the voyage up the west coast of South America made a few collections off the coast, but for the most part these are not now available and nothing has as yet been published on them. Berry published a short note<sup>2</sup> on a new *Nonion* from the coast of Peru. His species we have found in some numbers in some of the samples we have studied. Altogether this is one of the least known of the oceanic areas unless we except the Western coast of Africa.

Very few of the forms are new but a few of them appear to be undescribed. Nearly all of the species are illustrated and we have to thank Miss Margaret S. Moore for her painstaking work in making the drawings from selected specimens. The following are the species obtained in the collections:

### Family SACCAMMINIDAE

#### Genus PROTEONINA Williamson, 1858

##### PROTEONINA FUSIFORMIS Williamson

Plate 1, figure 1

*Proteonina fusiformis* WILLIAMSON, Rec. Foram. Gt. Britian, 1858, p. 1, pl. 1, fig. 1.—RHUMBLER, Arch. Prot., vol. 3, 1903, p. 248, fig. 84 (in text).—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 41, fig. 39 (in text); Bull. 104, U. S. Nat. Mus., pt. 1, 1918, p. 47; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 49.

*Reophax fusiformis* (of Authors).

There is a single fusiform specimen from Lota, Chile. It has an arenaceous test and apparently a single chamber. The species is a widely distributed one known from a number of stations in the Pacific at various depths.

#### Genus SOROSPHAERA H. B. Brady, 1879

##### SOROSPHAERA CONFUSA H. B. Brady

Plate 1, figure 2

*Sorosphaera confusa* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 28, pl. 4, figs. 18, 19; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 251, pl. 18, figs. 9, 10.—WOODWARD, The Observer, vol. 4, 1893, p. 78.—KIAER, Rep't. Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 14.—RHUMBLER, Arch. Prot., vol. 3, 1903, p. 235, fig. 63 (in text).—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 37, figs. 31, 32 (in text).—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1000.—CUSHMAN, Bull. 104, U. S. Nat.

<sup>2</sup>Journal of Paleontology, vol. 1, No. 4, 1923, p. 269.

Mus., pt. 1, 1918, p. 39, pl. 15, figs. 4, 5; Contrib. Canadian Biol., 1921 (1922), p. 4.—HERON-ALLEN and EARLAND, British Antarctic Exped., Zool., vol. 6, 1922, p. 84.—CUSHMAN, Spec. Publ. No. 1, Cushman Lab. Foraminif. Res., 1928, pl. 3, figs. 17, 18.

The records for this species are mostly from relatively cold water. Specimens are recorded from both the Arctic and Antarctic with a few intermediate records. The single specimen figured here is from off Payta, Peru, attached to a flake of mica.

Attention should be drawn to the peculiar forms figured by Heron-Allen and Earland from the Antarctic under the names *Trochammmina uviformis* Grzybowski and *T. moniliformis* Heron-Allen and Earland which somewhat resemble our specimen.

### Family TEXTULARIIDAE

#### Genus TEXTULARIA DeFrance, 1824

TEXTULARIA, species (?)

Plate 1, figures 4 a, b

The figured specimen is broken at both ends and is the only one of this particular form found in the collection. The wall is thin, and the whole test much compressed. It is from off Eten, Peru.

#### Genus BIGENERINA d'Orbigny, 1826

BIGENERINA DELICATULA, new species

Plate 1, figures 3, 5

Test minute, elongate, slender, slightly tapering, somewhat compressed, early chambers biserial, later ones uniserial, the relative number of each group very variable; periphery rounded; earlier chambers low and broader than high, later ones increasing in height; sutures fairly distinct, very slightly depressed; wall composed of comparatively large arenaceous fragments, with a small amount of cement, the whole wall easily collapsible when wet; aperture terminal in the adult, narrowly elliptical.

Maximum length, 0.35 mm.; breadth, 0.12 mm.; thickness, 0.06 mm.

*Holotype*—(Cat. No. 20783, U.S.N.M.). From off Payta, Peru.

This species is abundant at this locality, and specimens were also obtained in material from off Pinatel, Peru. It is a small, very delicate species and rather uniform in size. The larger specimens, which are apparently microspheric, assume the uniserial character fairly soon, but there are other smaller ones which prolong the biserial character, and if it were not that the forms occur together and are of the same general size and appearance, might be thought to be *Textularia*.

## Family MILIOLIDAE

## Genus QUINQUELOCULINA d'Orbigny, 1826

## QUINQUELOCULINA, species (?)

Plate 1, figures 6 a, b

The broken specimen here figured has a few longitudinal striations, but it is impossible to determine whether this is an adult or not and so no attempt has been made to place it specifically. It is from off Santa Elena, Ecuador.

## QUINQUELOCULINA, species (?)

Plate 1, figures 7 a-c

This smooth form also from off Santa Elena, Ecuador, has not enough specimens to give full specific characters. It appears to be quinqueloculine, but may be only the early stage of a smooth *Triloculina*. A very few specimens of this group were also obtained from off Corral, Chile, but not enough for identification.

## Family TROCHAMMINIDAE

## TROCHAMMINA PERUVIANA, new species

Plate 1, figures 8 a, b

Test trochoid, spire greatly flattened, dorsally very slightly convex, ventrally slightly concave, consisting of three or four whorls; chambers numerous, 10 or more in the last-formed whorl, of rather uniform size and shape increasing slowly in size as added; sutures on the dorsal side gently curved, very slightly depressed, only those of the last-formed whorl distinct, on the ventral side gently curved or with a sinuous, lobed condition especially in later portions, distinct; wall finely arenaceous with much chitin, thin, very flexible when wet; aperture ventral, along the inner margin of the last-formed chamber.

Diameter, 0.45 mm.

*Holotype*.—(Cat. No. 20784, U.S.N.M.) From off Eten, Peru.

This species is closely allied to *Trochammina ochracea* Williamson and *T. plicata* Terquem. The peculiar sinuous arrangement of the ventral side is different from either of these, of each of which we have had excellent series of recent European specimens for comparisons.

## Family NONIONIDAE

## Genus NONION Montfort, 1808

## NONION PIZARRENSIS Berry

Plate 1, figures 10 a, b; plate 2, figures 1 a, b

*Nonion pizarrensis* BERRY, Journ. Pal., vol. 1, 1927-28 (1928), p. 269, figs. 1-3 (in text).

Test nearly bilaterally symmetrical, slightly longer than broad in side view, periphery broadly rounded, umbilici depressed but not

open; chambers 12–15 in the last-formed coil, elongate, curved, the apertural face convex; sutures distinct, depressed strongly at the inner end, becoming less so toward the periphery, gently curved; wall smooth, polished, very finely perforate; aperture elongate, at the base of the apertural face, often slightly more extended on one side than the other.

Length, 0.50–0.63 mm.; breadth, 0.38–0.46 mm.; thickness, 0.22–0.26 mm.

Berry recently described this species from about 8 fathoms of water at the mouth of the Tumbes River at Puerto Pizarro, Peru. We have had specimens from Payta and Pimentel, Peru, which are evidently this same species. The adult specimens have slightly more chambers than does the type, but the measurements and proportions show that there is a single species in the series. There is a tendency as noted by Berry for the test to become slightly asymmetrical.

#### Genus NONIONELLA Cushman, 1926

##### NONIONELLA AURIS (d'Orbigny)

Plate 1, figure 9; plate 2, figures 2, 3

*Valvulina auris* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 47, pl. 2, figs. 15–17.

Test asymmetrical, slightly trochoid, the spire not raised, periphery in the adult broadly rounded; chambers 9–11 in the adult, low and broad, very distinct, slightly inflated, in the adult with the last-formed chamber having an enlarged portion extending over the umbilicus on the ventral side; sutures distinct, depressed, gently curved; wall smooth, polished, very finely perforate; aperture at the base of the last-formed chamber extending from the periphery ventrally, low and broad.

Maximum length, 0.40 mm.; breadth, 0.30 mm.; thickness, 0.18 mm.

D'Orbigny described this species from many localities along the west coast of South America from Chile to Ecuador saying that it makes up nine-tenths of the foraminifera of the Peruvian coast. We have found it in material from Payta, Pimentel, and Eten, Peru, and from Corral and Lota, Chile. The bulbous expansion of the chamber on the ventral side is often not taken on until the specimen is fully developed and specimens in this state are figured. Farther north and in the late Tertiary of California this is replaced by its probable ancestral form, *Nonionella miocenica* Cushman which has fewer and relatively larger chambers.

It was suspected that *Nonion pizarrensis* Berry might be the microspheric form of d'Orbigny's species but apparently they are distinct so far as the material we have will show. This relationship is however suggested for future studies.

**NONIONELLA CHILIENSIS, new species**

Plate 2, figures 4 a-c

Test asymmetrical, trochoid, the spire very much flattened, consisting of about  $2\frac{1}{2}$  whorls, periphery subacute, umbilicus depressed; chambers numerous, 10-12 in the last-formed whorl, low and broad, not inflated; sutures distinct, not depressed, strongly limbate, on the dorsal side oblique, ventrally strongly curved; wall smooth, polished, very finely perforate; aperture low, elongate, at the margin of the chamber extending from the periphery ventrally.

Maximum height, 0.40 mm.; breadth, 0.35 mm.; thickness, 0.18 mm.

*Holotype*.—(Cat. No. 20785, U.S.N.M.). From off Corral, Chile. It also occurs in material from Lota, Chile.

At first glance this might not be thought to be a *Nonionella*, but the general characters of the test are much like the others noted except for the greater amount of asymmetry and the limbate sutures.

**Genus ELPHIDIUM Montfort, 1808****ELPHIDIUM ALVAREZIANA (d'Orbigny)**

Plate 2, figures 5 a, b

*Polystomella alvareziana* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5 "Foraminifères," p. 31, pl. 3, figs. 11, 12.

There are a very few specimens from the coast of Chile off Lota and Corral that are very close to this species described from d'Orbigny from the Falklands and the coast of Argentina. The number of chambers, the general shape and character of the retral processes and of the umbilical region are similar to the figure given by d'Orbigny. Our specimens are somewhat thicker in peripheral view.

Diameter, 0.45 mm.; thickness, 0.20 mm.

**Family BULIMINIDAE****Genus BULIMINELLA Cushman, 1911****BULIMINELLA ELEGANTISSIMA (d'Orbigny)**

Plate 3, figures 1-3

*Bulimina elegantissima* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, No. 5, "Foraminifères," p. 51, pl. 7, figs. 13, 14.—SCHLUMBERGER, Feuille Jeun. Nat., vol. 12, 1881, pl. 1, fig. 14.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 402, pl. 50, figs. 20-22.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 11, pl. 2, fig. 6.—CHAPMAN, Rep't. Foram. Subantarctic Ids., New Zealand, 1909, p. 330; Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 18.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 122.—HERON-ALLEN and EARLAND, British Antarctic Exped., Zool., vol. 6, 1922, p. 129.

*Buliminella elegantissima* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 89; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 606; Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, 1925, p. 40, pl. 6, figs. 5 a, b.

This species is many times recorded in the literature, but from a study of specimens from many parts of the present oceans as well as fossil ones it is apparent that several distinct forms are included under this name. D'Orbigny originally described the species from the west coast of South America from Payta, Peru, Cobija, Bolivia (now Cobija, Chile), and Valparaiso, Chile, and off Cape Horn. It has occurred abundantly in our material from Payta, Eten, and Pimentel, Peru, and from Lota and Corral, Chile. It is evident that the species is one of the cooler waters of the western coast of the Americas and probably to be found in a wider distribution, but this is to be proved. The species is recorded often from the region of the British Isles, but specimens do not closely match those from South America. The specimens from Samoa and from the Miocene of Australia are not the same.

The different stages in development show considerable differences in form. Plate 3, figure 3, is a young specimen and corresponds closely to that named by Sidebottom, var. *fusiformis*.<sup>3</sup> An older specimen is shown in Figure 2. An adult probably of the megalospheric form is shown in Plate 3, Figure 1.

### Genus BULIMINA d'Orbigny, 1826

#### BULIMINA PATAGONICA d'Orbigny

Plate 3, figures 4 a, b

*Bulimina patagonica* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 50, pl. 1, figs. 8, 9.—CUSHMAN and WICKENDEN, Proc. U. S. Nat. Mus., vol. 75, 1929, p. 8, pl. 3, figs. 11 a, b.

D'Orbigny described this species in his South American monograph. It is allied in some respects to *B. marginata* and *B. pulchella*. It has a very distinctive set to the chambers and the teeth at the base of the chamber are never large nor are they usually regular. The specimens are from off Payta, Peru.

The species also occurs off Juan Fernandez.

### Genus VIRGULINA d'Orbigny, 1826

#### VIRGULINA, species (?)

Plate 3, figures 5-7.

There are a few specimens such as figured here which are somewhat of a puzzle. They are smooth, and resemble the form called *Bulimina patagonica* d'Orbigny, var. *glabra* Cushman and Wickenden, but tend to become biserial in the later portion. No definite species of *Virgulina* was found in the collection.

<sup>3</sup>Journ. Roy. Micr. Soc., 1918, p. 123, pl. 3, figs. 8-10.

Genus *BOLIVINA* d'Orbigny, 1839*BOLIVINA COSTATA* d'Orbigny

Plate 3, figures 9 a-c

*Bolivina costata* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 62, pl. 8, figs. 8, 9.

Test small, tapering, broadest toward the apertural end in both front and side views, periphery broadly rounded; chambers numerous, the earlier ones low and broad, later ones becoming gradually higher until in the last-formed ones the height is often nearly equal to the breadth, slightly inflated; sutures somewhat indistinct, but appearing as irregular angular lines between the sutures pointing toward the aperture, due to the suture line extending out onto the costae and backward at the same time; wall very coarsely perforate, with a few sharp, raised longitudinal costae continuous over the sutures, usually five or six costae on a side, last-formed chambers of each series usually smooth on the outer face; aperture narrow, elliptical, extending in from the base nearly in the median line.

Maximum length, 0.40 mm.; breadth, 0.15 mm.; thickness, 0.12 mm.

D'Orbigny's types are from Cobija, Chile, in d'Orbigny's time Bolivian territory. In our material, the species has proved to be very abundant at Eten, less so at Pimentel, and rather scarce at Payta, Peru. It did not occur in the material from Chile or Ecuador. It is by far the dominant species at Eten, occurring by hundreds and showing very little variation. It is identical with d'Orbigny's figure and description, but not at all the same as *Bolivina costata* of Brady in the *Challenger* report.

*BOLIVINA DONIEZI* Cushman and Wickenden

Plate 3, figures 8 a, b

*Bolivina doniezi* CUSHMAN and WICKENDEN, Proc. U. S. Nat. Mus., vol. 75, 1929, p. 9, pl. 4, figs. 3 a, b.

Test small, depressed, broadest near the apertural end; chambers comparatively few, consisting of eight or ten pairs; wall very coarsely perforate, the earlier chambers with a few coarse perforations near the basal margin, the adult chambers with the coarse perforations scattered over the general surface; chambers fairly narrow, but becoming higher toward the apertural end; sutures distinct, depressed, strongly oblique; aperture elongate, arched, in the median line at the base of the last-formed chamber.

Length of figured specimen, 0.21 mm.; breadth, 0.10 mm.; thickness, 0.7 mm.

This species described from Juan Fernandez is very rare at Payta, Peru. Its characters hold very distinctly.



**Genus REUSSIA Schwager, 1877****REUSSIA SPINULOSA (Reuss)**Plate 3, figures 10 *a, b*

*Verneuilina spinulosa* REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 374, pl. 47, fig. 12.—(and later Authors).

*Reussia spinulosa* SCHWAGER, Boll. Com. Geol. Ital., vol. 8, 1877, p. 26, pl., fig. 66.

There is a single specimen of *Reussia* from off Santa Elena, Ecuador which may be referred to this species. The apertural end is incomplete.

**Family ROTALIIDAE****Genus DISCORBIS Lamarck, 1804****DISCORBIS ISABELLEANA (d'Orbigny)**Plate 3, figures 12 *a-c*

*Rosalina isabelleana* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 43, pl. 61, figs. 10-12.

*Discorbina isabelleana* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 646, pl. 88, figs. 1 *a-c* (?).

*Discorbis isabelleana* CUSHMAN, Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, 1927, p. 160, pl. 4, fig. 4.

*Discorbina vilardeboana* H. B. BRADY (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 645, pl. 88, fig. 2.

Test trochoid, in edge view biconvex, spire low; periphery acute but not carinate; six chambers in the last-formed coil, distinct, increasing regularly in size as added, ventrally with a slight lip in the umbilical region which is depressed; sutures very distinct, strongly curved; wall smooth, finely perforate; aperture, a narrow ventral slit below the umbilical border of the chamber.

Length, 0.25 mm.; breadth, 0.18 mm.; thickness, 0.10 mm.

This species is widely distributed along the Western Coast of the Americas. It is recorded under the name of *Discorbina vilardeboana* by various authors basing the determination on the *Challenger* figures rather than that of d'Orbigny which do not belong to the same species. Our specimens are from Lota, Chile, and Pimentel, Peru.

**DISCORBIS CHILIENSIS, new species**Plate 3, figures 11 *a-c*

Test plano-convex, dorsal side strongly convex, ventral side flattened or concave, periphery acute but not carinate, somewhat involute on the dorsal side; chambers distinct, about seven in the last-formed whorl, slightly inflated on the ventral side and ending in a distinct angle at the umbilical end; sutures distinct, on the dorsal side slightly limbate and raised, strongly curved, on the ventral side depressed, gently curved; wall rather coarsely perforate; aperture on the ventral side below the umbilical margin of the chamber.

Length, 0.30–0.35 mm.; breadth, 0.20–0.22 mm.; thickness, 0.10–0.12 mm.

*Holotype*.—(Cat. No. 20786, U.S.N.M.) From off Lota, Chile.

At the type locality the specimens show a considerable range of variation. The spire may become somewhat higher and the whole test slightly more rounded. The amount of limbation of the sutures may be greater in the earlier coils and slightly less than shown in the adult. The test has a peculiar silvery-white, opaque appearance in all specimens seen. There is a single specimen from Eten, Peru, that is probably the same.

**DISCORBIS CONSOBRINA (d'Orbigny)**

Plate 4, figures 1, 2

*Rosalina consobrina* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 46, pl. 7, figs. 4–6.

Test biconvex, the dorsal side more strongly so, ventral side depressed in the umbilical region, periphery rounded; chambers five to seven in the last-formed whorl, distinct, regularly increasing in size as added, slightly inflated, on the ventral side ending in distinct angles on the umbilical end; sutures distinct, on the dorsal side oblique, very slightly curved, very little if at all depressed, on the ventral side slightly curved, nearly radial, depressed; wall smooth, distinctly perforate; aperture below the distinct lip on the ventral side of the chamber and extending into the umbilical region.

Diameter, 0.30 mm.; height, 0.22 mm.

D'Orbigny described this species from off the coast of Peru, and it has occurred in our material from off Payta and Eten, Peru, and Corral, Chile. Plate 4, figure 1 shows the microspheric form which has many more chambers and more coils and a higher spire than in the megalospheric form (fig. 2). D'Orbigny's figured specimen was evidently a megalospheric one. A comparison of figure 2 with d'Orbigny's type figure will show the very close similarity of the two.

**Genus EPONIDES Montfort, 1808**

**EPONIDES PERUVIANA (d'Orbigny)**

Plate 4, figures 5 a–c

*Rosalina peruviana* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 35, pl. 2, figs. 3–5.

Test trochoid, nearly equally biconvex, periphery carinate, generally circular in outline; chambers numerous, distinct, about eight in the last-formed whorl, on the dorsal side forming a very even polished surface, ventrally inflated, giving a very distinct appearance to the test; sutures very distinct on the dorsal side, curved, flush with

the surface, slightly limbate, on the ventral side radial, depressed; wall smooth, very finely perforate; aperture ventral, at the base of the chamber between the periphery and the umbilicus.

Diameter, 0.40 mm.; thickness, 0.25 mm.

D'Orbigny gives the following localities, common on the coast of Peru near the island of San Lorenzo, harbor of Callao and Arica; in sands from the island of Puna, at the mouth of the Rio de Guayaquil also at Valparaiso, Chile; Cobija, Bolivia (now Cobija, Chile), and at Payta and Acapulco, Peru. D'Orbigny says that it is probably to be found along the whole coast from 34° S. latitude to the equator.

In our material it was common at Lota, Chile, less so at Corral, Chile, and Payta, Peru.

This is a very distinctive species excellently illustrated by d'Orbigny. It is probably the same in part at least as the recent species referred by Brady to the cretaceous species *Rotalia karsteni* Reuss. In the *Challenger* report there is a small species recorded from numerous stations about the southern part of South America and a larger very similar one from the Arctic. Although the figures of these two in the *Challenger* plates look very much alike, it would seem to be worthy of interest to compare closely, specimens from these widely separated areas.

**EPONIDES REPANDA (Fichtel and Moll)**

Plate 4, figures 7 a-c

There are specimens from Santa Elena, Ecuador, that are very typical of this species as figured by Brady in the *Challenger* report, and by other authors. Whether or not these are the same as the original species of Fichtel and Moll is a matter to be left for further studies of specimens from the type localities. It is a thick-walled species of good size and evidently limited in its distribution in this area, not occurring in the collections from the more southern localities.

**EPONIDES MERIDIONALIS, new species**

Plate 4, figures 4, 6

Test trochoid, nearly circular, nearly equally biconvex, periphery in the young somewhat rounded, in the adult acute and carinate; chambers very distinct but not inflated, gradually increasing in size as added, about 12 in the last-formed coil in the adult; sutures distinct, limbate and with a raised ornamentation, oblique and slightly curved dorsally, nearly radiate ventrally; wall finely perforate, ornamented on the dorsal side by the raised sutural thickening and the thickened peripheral border of the chambers, on the ventral side by the beaded or raised suture lines often ending in a series of small knobs in the center and in some specimens with thickly scattered

raised beadlike protuberances covering the whole chamber wall between the radial sutures; aperture low, elongate, on the proximal third of the ventral border.

*Holotype*.—(Cat. No. 20787, U.S.N.M.). From off Corral, Chile. It occurred also off Lota, Chile and Pimentel, Peru in considerable numbers. The early stages are shown in plate 4, figure 4 *a-c*, and the adult characters in figures 6 *a-c*. The umbilicus is filled but does not have an isolated plug as in *Rotalia*.

**EPONIDES, species (?)**

Plate 4, figures 3 *a-c*

The small form figured is from off Pimentel, Peru. It is figured for record as it is evidently not an adult specimen and there are no others to give detailed characters.

**Genus ROTALIA Lamarck, 1804**

**ROTALIA INCA (d'Orbigny)**

Plate 5, figures 1 *a-c*

*Rosalina inca* D'ORBIGNY, Voy. Amér. Mérid., 1839, vol. 5, No. 5, "Foraminifères," p. 45, pl. 7, figs. 1-3.

Test trochoid, nearly circular in outline, biconvex, of about four whorls, the ventral side more convex than the dorsal, periphery rounded; chambers numerous and very distinct, uniformly increasing in size as added, 10 to 13 in the last-formed coil in the adult, somewhat inflated on the ventral side, ending at the umbilical end in distinct angles; sutures very distinct, slightly limbate above, oblique, not depressed nor raised, below nearly radial, deeply excavated, widening and deepening toward the umbilical end, umbilicus with a plug often broken on the exterior into several small bosses; wall on the dorsal side, smooth and polished, ventrally with two distinct areas, the sides of the chamber especially near the inner end very clear and with extremely fine pores, the middle portion of each chamber with coarser pores and much less clear wall; aperture on the ventral side part way between the periphery and central plug.

Diameter, 0.75 mm.; thickness, 0.40 mm.

This is evidently the species described by d'Orbigny as common from Callao, Peru. He says it is related to his *Rosalina parkinsoniana* which is evidently in turn related to *Rotalia beccarii* (Linnaeus). This is one of the most abundant species at Corral, Chile, but not found at other stations in the collections. It does not have the beaded edges on the ventral side so characteristic of *R. beccarii* in its typical form and seems to be close to the forms described from the West Indies but not identical. It is one of the species of the *R. beccarii* group that should be distinguished in various regions.

**ROTALIA ROSEA d'Orbigny**

Plate 5, figures 2, 3

*Rotalia rosea* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 272, No. 7; Modèles No. 36.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 24, pl. 3, figs. 7-9.

*Rotalina rosea* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 72, pl. 3, figs. 9-11.

*Truncatulina rosea* H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 667, pl. 96, fig. 1.—FLINT, Ann. Rep't U. S. Nat. Mus., 1897 (1899), p. 334, pl. 78, fig. 2; Bull. U. S. Fish Commission No. 484, 1900, p. 416.—CUSHMAN, Proc. Boston Soc. Nat. Hist., vol. 34, No. 2, 1908, p. 30; Carnegie Instit. Washington, Publ. 213, 1918, p. 284; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 56, pl. 13, figs. 1-3; Publ. 311, Carnegie Instit., 1922, p. 46, pl. 14, figs. 3-5; Publ. 344, 1925, p. 78.

Test trochoid, biconvex, the dorsal side often with a high spire, periphery acute, or with small spinose projections or with irregular plate-like extensions at each chamber, umbilical area with a distinct plug; chambers usually 9 to 10 in the last-formed whorl, increasing gradually in size as added, not inflated; sutures limbate but not raised, oblique on the dorsal side, nearly radial on the ventral side, flush on the dorsal side, depressed on the ventral side; wall coarsely perforate, smooth or ornamented with bead-like projections, especially near the periphery; aperture, an elongate slit at the inner margin of the ventral side of the chamber, with a considerable lip developed above it, color rose-red to reddish brown.

Diameter averaging about 0.40 mm.

The only station for this species in the material is Santa Elena, Ecuador, where it was fairly common. It shows the various forms that it develops in the West Indian region and the record is interesting as showing the occurrence of a typical restricted West Indian species on the Pacific side of America. Evidently this tropical fauna extends about as far south as the great western angle of South America after which it gives way to a colder-water fauna extending far to the south.

## Family CYMBALOPORETTIDAE

### Genus TRETOMPHALUS Moebius, 1880

#### TRETOMPHALUS BULLOIDES (d'Orbigny)

*Rotalina bulloides* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 104, pl. 3, figs. 2-5.

*Cymbalopora bulloides* CARPENTER, PARKER, and JONES, Introd. Foram., 1862, p. 216.—H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 638, pl. 102, figs. 7-12; text figs. 20 a-c.

*Tretomphalus bulloides* MOEBIUS, Beitr. Meeresfauna Insel Mauritius, 1880, p. 98, pl. 10, figs. 6-9.—CUSHMAN, Publ. 311, Carnegie Instit. Washington, 1922, p. 42, text figs. 2, 3; Publ. 342, 1924, p. 36, pl. 11, figs. 1-3.—

CUSHMAN and WICKENDEN, Proc. U. S. Nat. Mus., vol. 75, 1929, p. 12, pl. 5, figs. 2-4.

Test free, subglobular, early chambers rotaliform, numerous, rather coarsely perforate, forming a cap to which is attached in the adult pelagic stage a large final "balloon-chamber," subspherical, with coarse perforations on the ventral side and within, a "float-chamber" with a single opening at the base from which a tubular neck projects inward; color of the early chambers dark brown, the large chamber colorless.

Diameter, 0.50 mm.

The only specimens in the collection are from the station off Santa Elena, Ecuador, at which the other tropical West Indian species were present. It is a very widely distributed species on account of its pelagic habit in the adult.

## Family GLOBIGERINIDAE

### Genus GLOBIGERININA d'Orbigny, 1826

#### GLOBIGERINA BULLOIDES d'Orbigny

There is a single rather typical specimen of this species from off Santa Elena, Ecuador. In the collections along the coast northward to Oregon the species is represented by very few specimens and some of these may be the young of *Globigerinoides sacculifera* H. B. Brady.

#### GLOBIGERINA CONGLOMERATA Schwager

*Globigerina conglomerata* SCHWAGER, *Novara* Exped., Geol. Theil., pt. 2, 1866, p. 255, pl. 7, fig. 113.—CUSHMAN, Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, 1927, p. 172.

*Globigerina dutertrei* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 601, pl. 81, figs. 1 a-c (not d'Orbigny).

*Globigerina dubia* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 79, figs. 17 a-c (not Egger).

Test subglobose, in the early stages consisting of but four chambers in each whorl, closely grouped; aperture small and with a distinct lip; in later stages with five or six chambers in the whorl, the last whorl usually below the level of the preceding ones and with a distinct umbilicus.

This species described by Schwager from the Pliocene of Kar Nicobar is the most common species in the late tertiary and recent collections from the Pacific region. We have specimens for comparison from the original material of Schwager's from Kar Nicobar.

### Genus GLOBIGERINELLA Cushman, 1927

#### GLOBIGERINELLA AEQUILATERALIS (H. B. Brady)

*Globigerina aequilateralis* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 71; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 605, pl. 80, figs. 18-21.—CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 5, 1924, p. 25, pl. 4, figs. 7, 8.

*Globigerinella aequilateralis* CUSHMAN, Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, 1927, p. 174.

Test composed of numerous inflated chambers, trochoid in the young, later in a bilaterally symmetrical, planispiral coil; chambers increasing rapidly in size as added, usually five or six visible in side view; sutures much depressed; wall reticulate; aperture, a large arched opening at the base of the chamber.

The only specimen is from off Eten, Peru. Like the specimen noted from farther north along the coast, the coil is much less open than is usual in specimens from the Tropical Atlantic.

## Family ANOMALINIDAE

### Genus ANOMALINA d'Orbigny, 1826

*ANOMALINA SCHMITTI* Cushman and Wickenden

Plate 5, figures 4 a-c

*Anomalina schmitti* CUSHMAN and WICKENDEN, Proc. U. S. Nat. Mus., vol. 75, 1929, p. 14, pl. 6, figs. 5 a-c.

Test with the dorsal side flattened, ventral side, especially in the central portion forming a fairly high spire, last-formed coil evolute on both sides, periphery smooth, keeled, especially in the earlier portion; chambers eleven to twelve in the last-formed coil in the adult, not inflated; sutures distinct, especially between the last few chambers, very slightly depressed, slightly limbate on the dorsal side, gently curved; wall coarsely perforate, especially on the dorsal side; aperture low, broad, at the peripheral margin.

Length, 0.45 mm.; breadth, 0.35 mm.; thickness, 0.20 mm.

This species has been recently described from Juan Fernandez. It is interesting to record several specimens from Corral, Chile, although it did not occur at any of the other stations. The high spire is a striking character although it is somewhat variable.

## EXPLANATION OF PLATES

### PLATE 1

- FIGURE 1. *Proteonina fusiformis* Williamson.  $\times 110$ .  
 2. *Sorosphaera confusa* H. B. Brady.  $\times 110$ .  
 3, 5. *Bigenerina delicatula* Cushman and Kellett, new species. Fig. 3,  $\times 150$ . Young. Biserial stage. Fig. 5,  $\times 110$ . Adult. Uniserial stage. a, front views; b, apertural views.  
 4. *Textularia* species (?)  $\times 150$ . a, front view; b, apertural view.  
 6. *Quinqueloculina* species (?)  $\times 60$ . a, front view; b, apertural view.  
 7. *Quinqueloculina* species (?)  $\times 60$ . a, front view; b, side view; c, apertural view.  
 8. *Trochammina peruviana* Cushman and Kellett, new species.  $\times 110$  a, dorsal view; b, ventral view.  
 9. *Nonionella auris* (d'Orbigny).  $\times 95$ . a, b, opposite sides; c, peripheral view.  
 10. *Nonion pizarrensis* Berry.  $\times 95$ . a, side view; b, peripheral view.

## PLATE 2

- FIGURES 1. *Nonion pizarrensis* Berry.  $\times 95$ . *a*, side view; *b*, peripheral view.  
 2, 3. *Nonionella auris* (d'Orbigny).  $\times 95$ . *a*, *b*, opposite sides; *c*, peripheral views.  
 4. *Nonionella chiliensis* Cushman and Kellett, new species.  $\times 95$ . *a*, *b*, opposite sides; *c*, peripheral view.  
 5. *Elphidium alvareziana* (d'Orbigny).  $\times 110$ . *a*, side view; *b*, peripheral view.

## PLATE 3

- FIGURES 1-3. *Buliminella elegantissima* (d'Orbigny).  $\times 110$ . Fig. 2*a*, side view; 2*b*, apertural view.  
 4. *Bulimina patagonica* d'Orbigny.  $\times 110$ . *a*, side view; *b*, apertural view.  
 5-7. *Virgulina* species (?).  $\times 150$ . *a*, front views; *b*, apertural views.  
 8. *Bolivina doniezi* Cushman and Wickenden.  $\times 150$ . *a*, front view; *b*, apertural view.  
 9. *Bolivina costata* d'Orbigny.  $\times 110$ . *a*, front view; *b*, side view; *c*, apertural view.  
 10. *Reussia spinulosa* (Reuss).  $\times 110$ . *a*, front view; *b*, apertural view.  
 11. *Discorbis chiliensis* Cushman and Kellett, new species.  $\times 110$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.  
 12. *Discorbis isabelleana* (d'Orbigny).  $\times 110$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

## PLATE 4

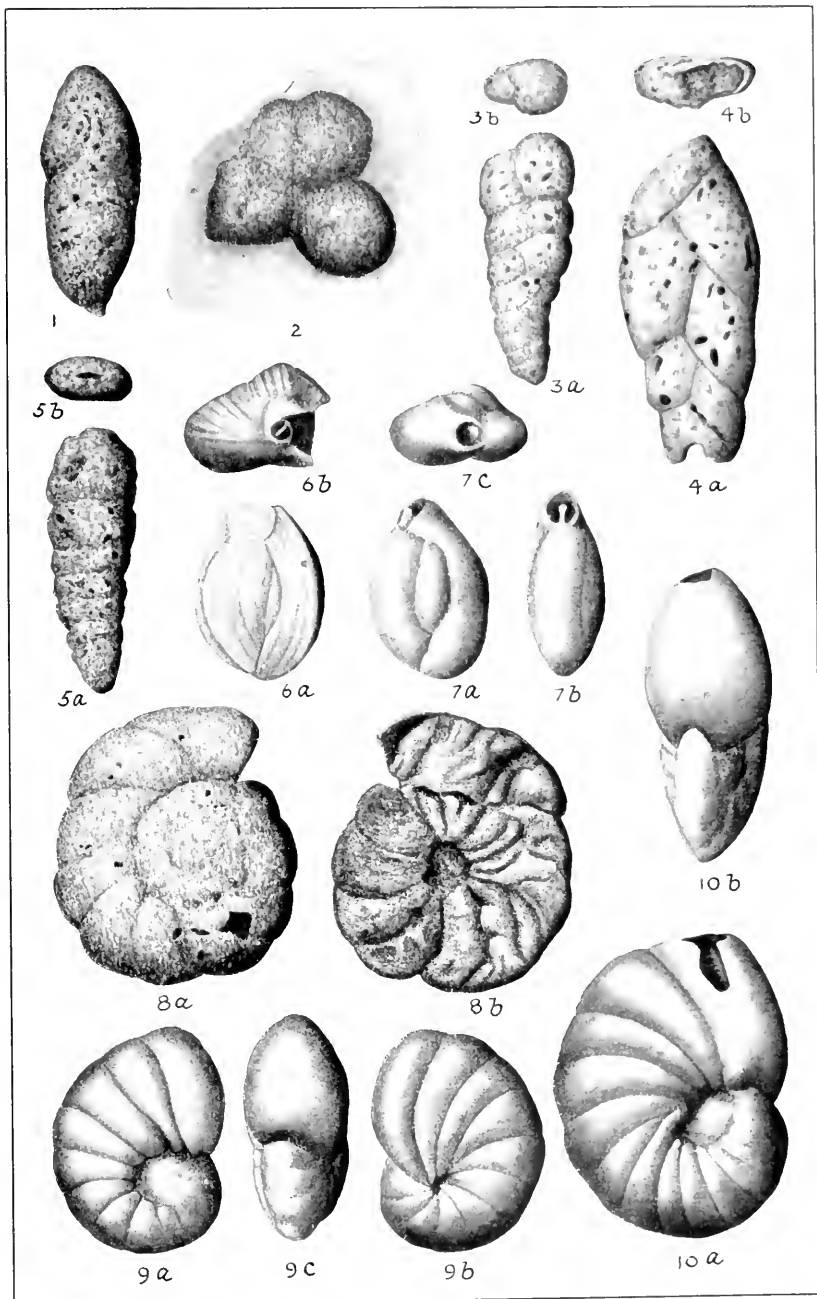
- FIGURES 1, 2. *Discorbis consobrina* (d'Orbigny).  $\times 110$ . *a*, dorsal views; *b*, ventral views; *c*, peripheral views.  
 3. *Eponides* species (?).  $\times 110$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.  
 4, 6. *Eponides meridionalis* Cushman and Kellett, new species. Fig. 4,  $\times 110$ . Fig. 6,  $\times 60$ . *a*, dorsal views; *b*, ventral views; *c*, peripheral views.  
 5. *Eponides peruwiana* (d'Orbigny).  $\times 60$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.  
 7. *Eponides repanda* (Fichtel and Moll).  $\times 60$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

## PLATE 5

- FIGURES 1 *a-c*. *Rotalia inca* (d'Orbigny).  $\times 60$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.  
 2, 3 *a-c*. *Rotalia rosea* d'Orbigny.  $\times 110$ . 3*a*, dorsal view; 3*b*, ventral view; 3*c*, peripheral view.  
 4 *a-c*. *Anomalina schmitti* Cushman and Wickenden.  $\times 110$ . *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

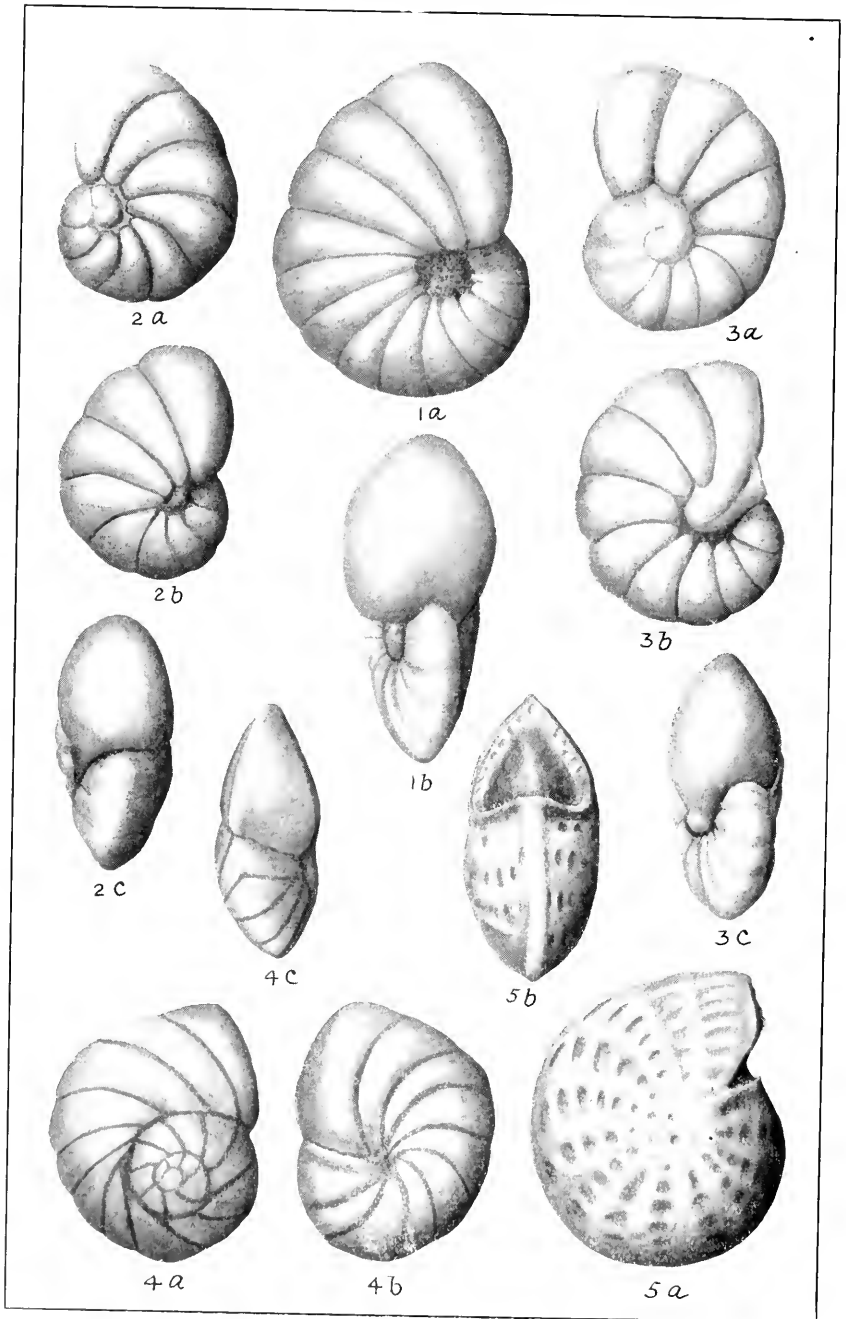






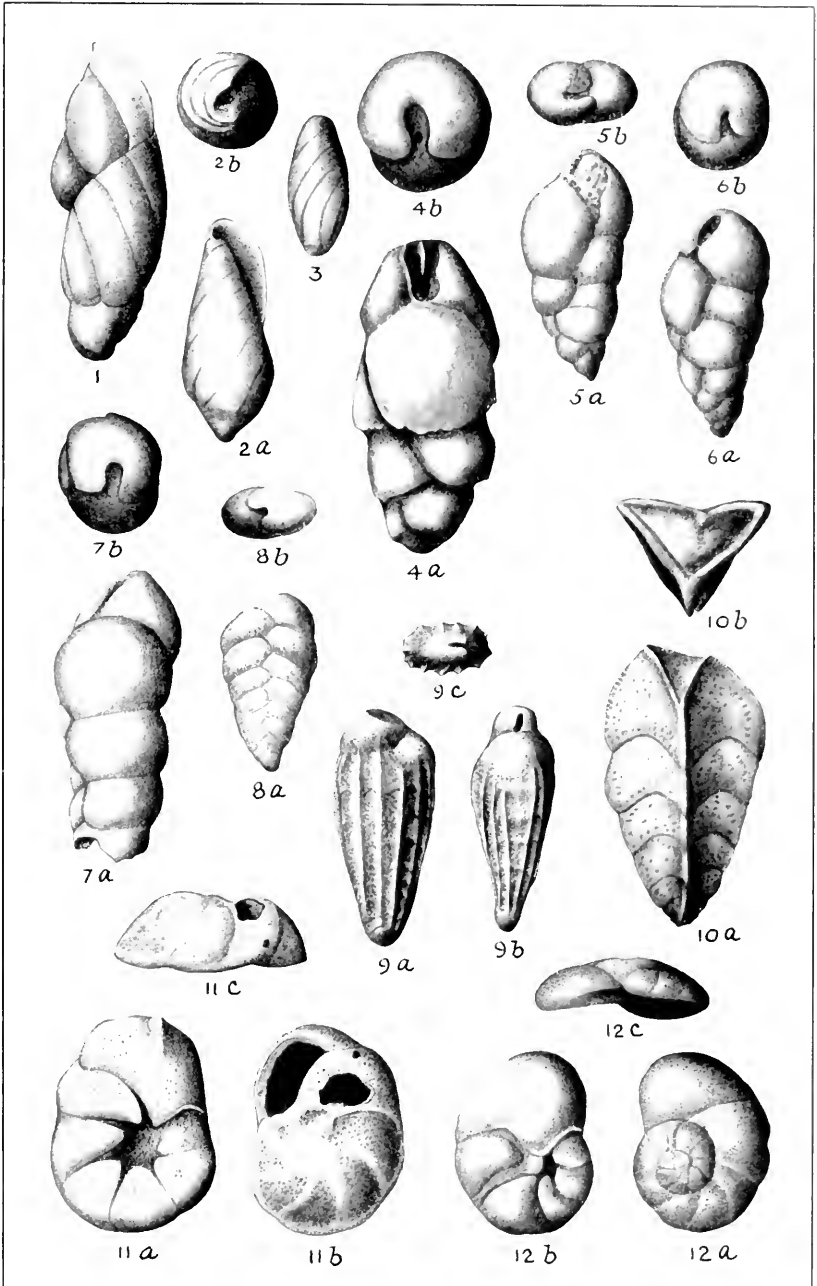
FORAMINIFERA FROM WEST COAST OF SOUTH AMERICA

FOR EXPLANATION OF PLATE SEE PAGE 15



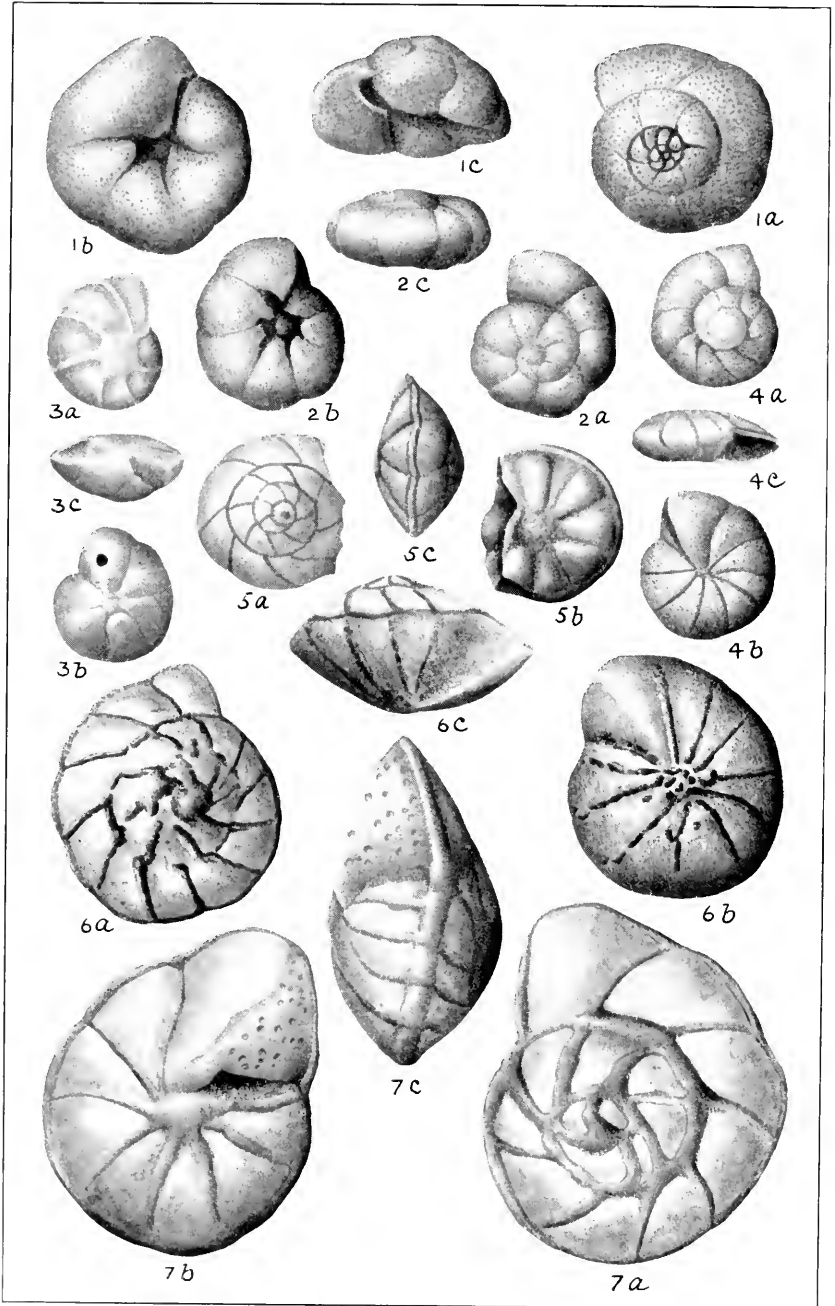
FORAMINIFERA FROM WEST COAST OF SOUTH AMERICA

FOR EXPLANATION OF PLATE SEE PAGE 16



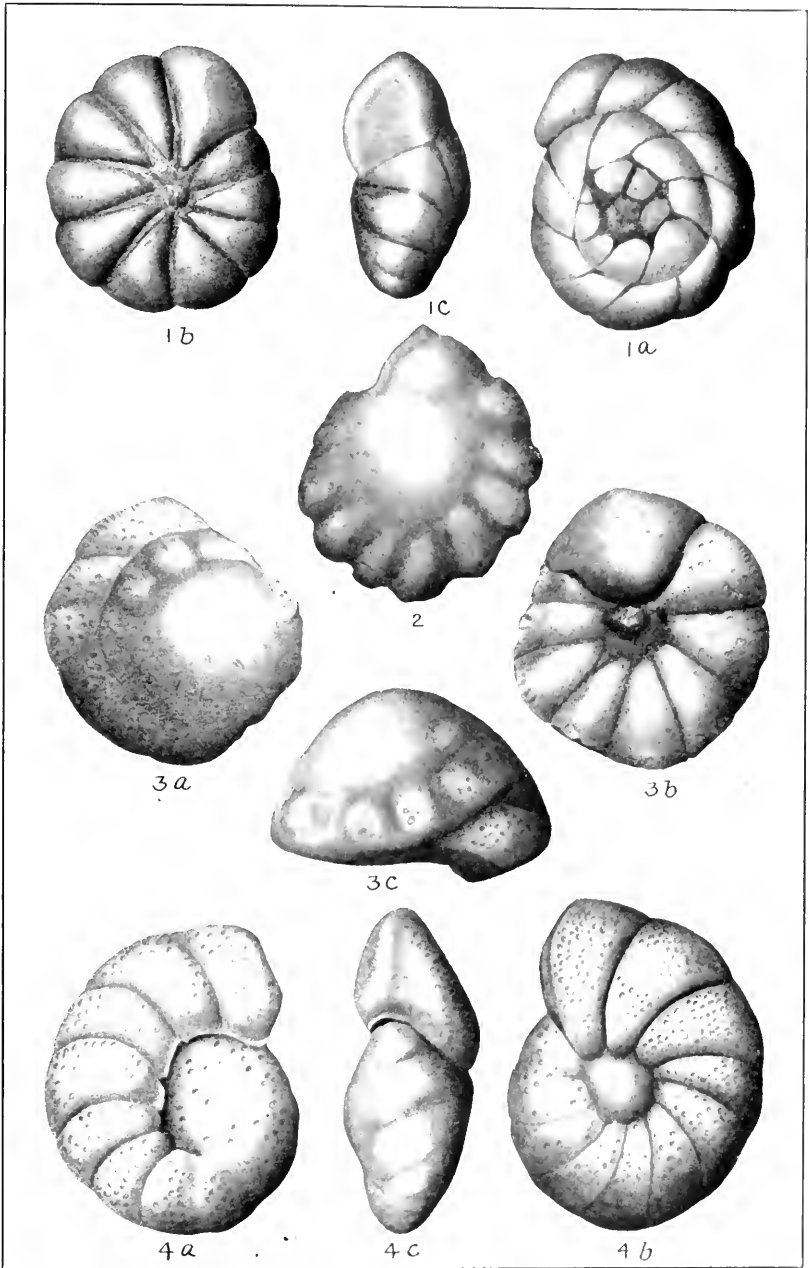
FORAMINIFERA FROM WEST COAST OF SOUTH AMERICA

FOR EXPLANATION OF PLATE SEE PAGE 18



FORAMINIFERA FROM WEST COAST OF SOUTH AMERICA

FOR EXPLANATION OF PLATE SEE PAGE 16



FORAMINIFERA FROM WEST COAST OF SOUTH AMERICA

FOR EXPLANATION OF PLATE SEE PAGE 16



## TWO NEW SPECIES OF POLYCHAETOUS ANNELIDS FROM THE ARGENTINE COAST

By A. L. TREADWELL

*Of Vassar College, Poughkeepsie, N. Y.*

Through the kind offices of the United States National Museum I have been enabled to study the annelids of the collections made by the well-known Uruguayan naturalist, Dr. Florentino Felippone, of Montevideo. In the material last sent me there are two new species described as *Halosydna grisea* and *Leodice argentinensis*. The types are in the collections of the National Museum.

### HALOSYDNA GRISEA, new species

The type (Cat. No. 19279, U.S.N.M.) (Felippone No. 3250), from the "coast of Argentina," is 40.5 mm. long; the greatest body width, measured to the margin of the elytron on either side, is 5 mm. The prostomium is 1 mm. wide, its length about equal to its width. The anterior margin of the prostomium is prolonged on either side into the cirrophore of the lateral tentacle, which is about half as long as the prostomium. (Fig. 1.) In the type the partially protruded pharynx pushes the prostomium dorsally so that the posterior margin is straight instead of notched and the narrowing at the base of each lateral cirrophore is not clearly seen. The anterior median groove is well marked and its postero-dorsal continuation divides the prostomium into hemispheres. The anterior eyes are larger than the posterior and are situated at the point of greatest width of the prostomium. Both pairs have lenses; the anterior one faces dorsally, the posterior one laterally. The prostomium (in preserved material) is colorless, the cirrophores and basal portions of the tentacles colored brown, with an uncolored portion at the cirrophore apex.

The tentacles are all rather slender, pigmented only toward their bases, of uniform diameter to the end, but terminating in a fine point. The style of the median tentacle is about as long as the prostomium and median cirrophore taken together. The styles of the lateral tentacles are more slender than the median and extend to about one-half its length. In the type only one palp remains, and this is badly broken. In another specimen the basal portion of the palp is one-half the width, and its total length fully five times the length of the

prostomium. It tapers very gradually to the apex, which is badly preserved, so that its precise form is uncertain. The tentacular cirri are shaped much like the lateral tentacles, and the ventral ones are about equal to them in length.

There are 21 pairs of elytra. The first pair are large, broadly oval in outline, and apparently in life completely cover the prostomium. Elytra 3 to 7 leave uncovered a considerable dorsal area in this preserved material, and it looks as if this holds true for the living animal as well. Behind the region of the eighth elytron the dorsal body surface is completely covered by the elytra. The last elytron is on the fourth somite from the pygidium. All elytra are similar in outline (fig. 2), and all are irregularly blotched with pigment. When the pigmentation is dense the point of attachment of the elytophore shows as a prominent white spot. In all cases this place is free from pigment, but when the pigment is more diffuse it is continuous with other unpigmented areas and hence is less prominent. The pigment is in small patches which may show as colored spots each with a colorless center, or the patches may be in contact, in which case the pigment is continuous with scattered white spots in it. The elytra toward the anterior end of the body have a few short marginal cilia, but I was unable to find any on those toward the median and posterior regions. Near the lateral margin of the elytron, and visible only under considerable magnification, are small blunt spines. For a certain distance these are arranged in a double row parallel with the elytron border, while others are irregularly scattered over the surface. They are not shown in Figure 2 because not visible at the magnification at which that was drawn.

The dorsal cirri are throughout equal in length to about one-half the body diameter. At the apex each tapers abruptly to an acute tip without any subterminal swelling. There evidently was in life a subterminal band of pigment. The posterior cirri are stouter than the others but similar to them in other respects, and the anal cirri resemble the last pair of dorsal ones.

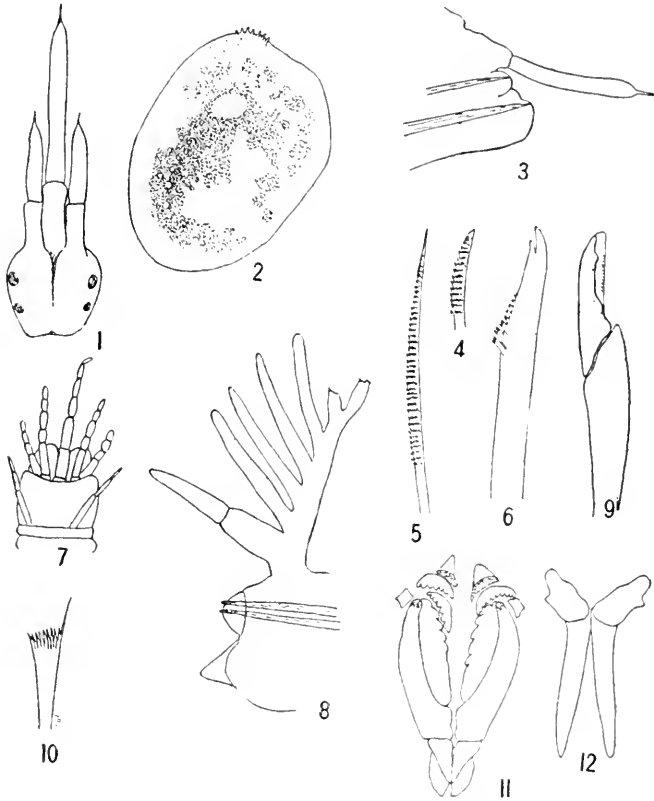
A parapodium (fig. 3) has a stout neuropodium, with very little distinction between anterior and posterior lips. The notopodium is globular in outline and is very small. The cirrophore of the dorsal cirrus is longer than the notopodium and its style extends for fully three-quarters of its length beyond the apex of the neuropodium. Each lobe of the parapodium has an acicula. The dorsal setae are of two kinds. The first (fig. 4) are stout and short, hardly extending beyond the notopodial apex. The shaft curves and narrows to an acute tip and there are rows of teeth along the convex margin. These setae form a fan-shaped bundle. The second kind are much longer and more slender, but carry a similar equipment of teeth (toothed plates). (Fig. 5.) The ventral setae (fig. 6) are very much



stouter and extend to about midway of the dorsal cirrus. The shaft is of uniform width to near the end, where it narrows to a blunt point. There is a subapical tooth, and there are rows of toothed plates proximal to the latter.

**LEODICE ARGENTINENSIS, new species**

In the collection are three specimens of *Leodice*, none of which is entire; but it seems best to record as much as possible, subject to



FIGURES 1-6.—*HALOSYDNA GRISEA*. 1, ANTERIOR END  $\times 10$ ; 2, ELYTRON  $\times 9.5$ ; 3, PARAPODIUM  $\times 7.5$ ; 4, DORSAL SETA  $\times 85$ ; 5, DORSAL SETA  $\times 85$ ; 6, VENTRAL SETA  $\times 85$ . FIGURES 7-12.—*LEODICE ARGENTINENSIS*. 7, ANTERIOR END  $\times 10$ ; 8, PARAPODIUM  $\times 27.5$ ; 9, COMPOUND SETA  $\times 250$ ; 10, PECTINATE SETA  $\times 250$ ; 11, MAXILLA  $\times 10.5$ ; 12, MANDIBLE  $\times 10.5$ .

correction if more material is available in the future. The largest of the three retains approximately 75 somites beside the head, these measuring 70 mm. in length. The peristomial width is 4 mm. and in the region of somite 10 the body width is 6 mm. Except that the tentacle tips are badly decomposed it is well preserved. One of the

others is so badly preserved that it is available only for setae and jaw study, while the third, very much smaller than the others, is in excellent preservation. This last has a prostomial width of 2 mm. and the first 34 somites are 15 mm. long. Behind the 34th somite the body is evidently undergoing regeneration for it is very slender and the appendages poorly developed. The drawing of the head and parapodia are taken from this specimen, that of the jaw from a much larger one. This should be remembered in considering the relative sizes of the two.

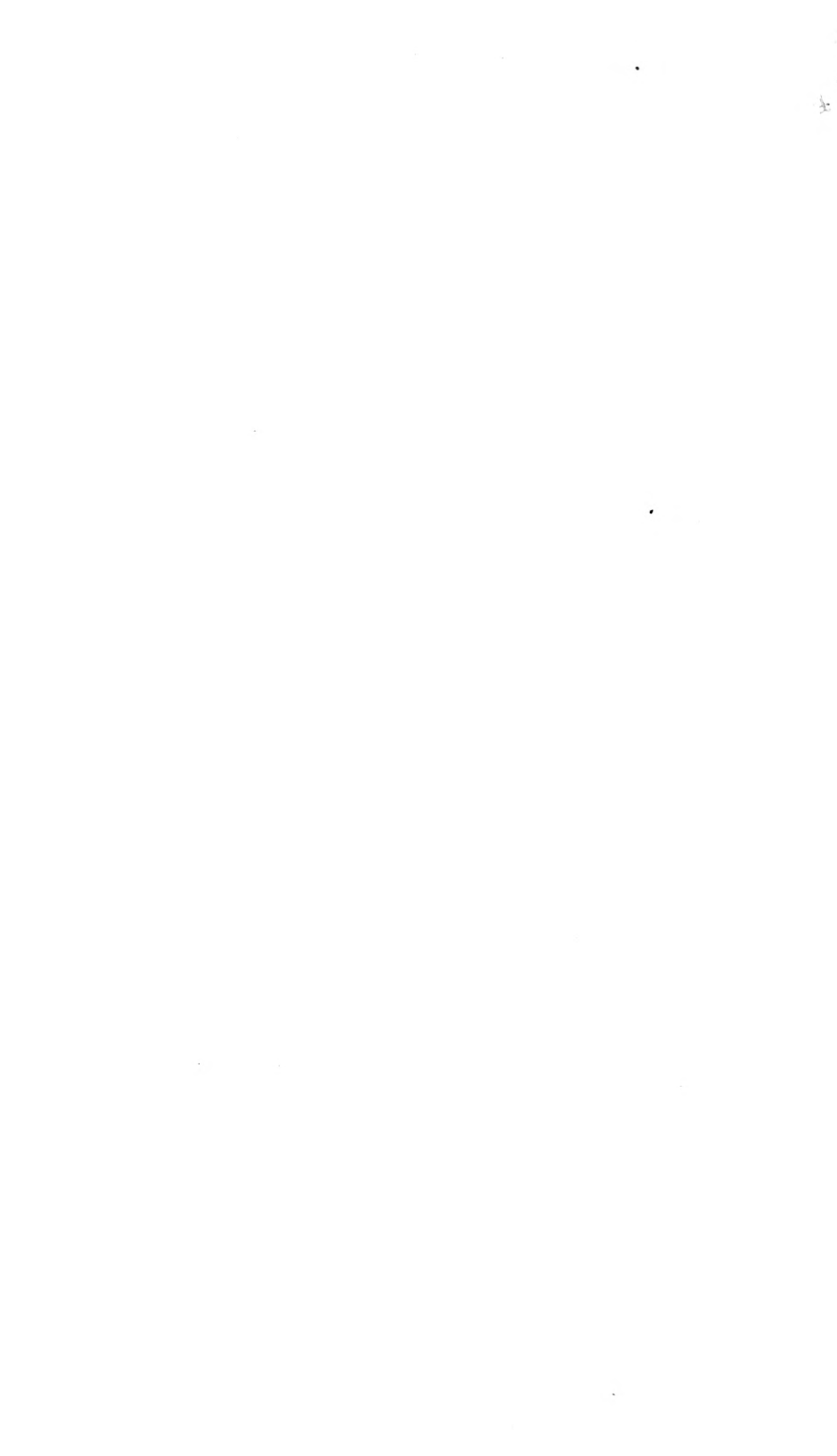
The prostomium (fig. 7) is bilobed, each half unusually rounded in outline, the eyes dark brown in color and with obvious lenses. The peristomium is about equal in length to the three following somites, its anterior margin straight, the anterior lateral angles only slightly rounded. The median tentacle extends as far as the anterior border of somite 7 and is composed of 6 joints, of which the first is about as long as the prostomium, the next a little shorter, the others shorter still but of about equal length. The intersegmental furrows are much more evident toward the distal end. The inner and outer paired tentacles are essentially similar in form to the unpaired but are progressively shorter. Somite 2 is about one-fourth as long as somite 1, and its nuchal cirri are very long, slender, and jointed. Throughout the body the dorsal cirri are rather stout, tapering in form, and two-jointed. (Fig. 8.)

In the small specimen the gills appear first as 2-branched organs on the third setigerous somite, in the larger animal they arise from this same somite and are 4-branched. In following somites the number in the smaller specimen are, respectively, 4, 5, and 6. In the larger they are 7, 8, and 9. In the latter animal there are 10 on somite 13. Between somites 5 and 22, where the body is widest, the gills are prominent and cover one-third of the dorsal surface of the body on either side. Behind somite 22 the body narrows and the gills become smaller and have fewer branches. They are present on the last somite of the fragment where they have three branches.

The tenth parapodium (fig. 8) has a setal lobe with a straight anterior lip and a longer pointed posterior one, with two straight aciculae coming to the surface between them. The ventral cirrus is a triangular lobe on the end of a globular swelling, the dorsal cirrus is stout and two-jointed. The main stem of the gill, which rises near the base of the dorsal cirrus, is almost equal to the cirrus in diameter and the diameter decreases very little up to beyond the point of origin of the fourth gill-branch. There are six branches, the tip of the last two having been broken in the one figured. Relatively to the size of the parapodium the gill structure is heavy. Posterior to about the twentieth somite the globular swelling which carries the ventral cirrus disappears and a ventral hooked acicula comes to the surface ventral to the setal lobe. All aciculae are black and visible to the naked eye as dark spots on the parapodia.

The compound setae (fig. 9) are stout, the apical joint having blunt apical and subapical teeth. There is a row of denticulations along the margin of the shield. The pectinate setae (fig. 10) are few in number in each somite and rather small. At the apex there are 10 teeth, of which the one at one end is much longer than any of the others. The simple setae are long and of the usual structure, with very minute striations along the margin. The jaw is sepia-colored, with very dark margins to the plates. The carrier is short, triangular in outline, with lateral lobes, the forceps rather heavy. (Fig. 11.) The right proximal paired plate has six teeth, the left has five. The right distal paired plate has nine, the left has seven, the unpaired has seven. Beyond each distal paired plate is a very dark triangular patch. The shafts of the mandibles are slender, sepia-brown in color, the terminal plate rather large and white. (Fig. 12.) The three fragmentary specimens may be considered as the cotypes of the species (Cat. No. 19280, U.S.N.M.) (Felippone No. 3008). They are from Mar del Plata, Argentina.











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